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ARCHAEOLOGICAL INVESTIGATIONS AT NELSON WASH, FORT IRWIN, CALIFORNIA

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ABSTRACT

The data recovery of seven early Holocene archeological sites in Nelson Wash, National Training Center, Fort Irwin, California was conducted during the summer of 1983. This report contains the description of artifacts recovered from these sites (4-SBr-4963, 4-SBr-4965, 4-SBr-4966, 4-SBr-4967, 4-SBr-4968, 4-SBr-4949 and 4-SBr-5267) followed by an analysis of use wear, assemblage composition, chronology, subsistence, and settlement patterns directed toward understanding early Holocene cultural adaptation in the Mojave Desert. A typological key for identifying Lake Mojave and Pinto points is proposed and evidence presented of a Lake Mojave-Pinto cultural continuum.

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CHAPTER 1 - INTRODUCTION by Claude N. Warren

PROJECT LOCATION

The U. S. Army National Training Center (NTC), Fort Irwin, California is located in the Mojave Desert approximately 56 km northeast of Barstow (Figure 1-1). The project area includes former Range 14/Nelson Wash in the Nelson Lake drainage basin, 11-13 km north of the NTC cantonment area.

PROJECT HISTORY

Archeological inventory of Nelson Wash was undertaken in January, February and March, 1982 prior to the 1982 Gallant Eagle training exercises. As a result of the initial survey, eleven prehistoric archeological sites were discovered and recorded in Area 6G including seven sites in the Range 14/Nelson Wash area (Robarchek et al. 1984, 99-115). In conjunction with the survey activities, limited subsurface testing was conducted at two of the Nelson Wash sites, 4-SBr-4966 and 4-SBr-4967 (168-179). As a result of the inventory, the seven Nelson Wash sites, 4-SBr-4963, 4SBr-4964, 4-SBr-4965, 4-SBr-4966, 4-SBr-4967, 4-SBr-4968 and 4-SBr-4969, were determined eligible for placement on the National Register of Historic Places under criterion d (36 CFR 60.4, Criteria of Evaluation).

Immediately following the Gallant Eagle exercises, the NTC selected the Range 14/Nelson Wash area as the site for the development of two live fire ranges to support tank gunnery and anti-armor training and to accommodate the Bradley Fighting Vehicle live fire training. The new ranges would include six of the seven Nelson Wash sites, excluding only 4-SBr-4964 located to the north of the project boundary. Construction and use of the ranges by the NTC would result in unavoidable impacts to the six sites within the range project boundaries; therefore, further evaluation of the sites to obtain sufficient information to guide data recovery was planned.

With the exception of 4-SBr-4966, however, testing and documentation of the Nelson Wash sites

was deferred, as there was a possibility that buried live ordnance was present in the project area. Evaluation of 4-SBr-4966 was restricted at this time to the collection of tools and debitage from the surface and the excavation of four 1x1 m test units to assess the extent, integrity and maximum depth of the site deposits (Skinner et al. 1984, 203-224).

Due to the urgency of the NTC range construction program, data recovery of the six Nelson Wash sites was undertaken from July to October, 1983 immediately following the completion of the 4-SBr-4966 evaluation, the completion of a research design and the clearance of unexploded ordnance from the Nelson Wash area by NTC personnel. Results of the field phase of the data recovery project were reported by Vaughan (1984). As the first phase of data recovery, heavy equipment was used to explore known or anticipated subsurface deposits at 4-SBr-4966, 4-SBr-4963 and 4SBr-4965. Subsequent data recovery efforts at these sites were based upon the results of the first phase. Data recovery at sites 4-SBr-4967, 4-SBr-4968 and 4-SBr-4969 was restricted to surface samples. In the course of the Nelson Wash data recovery fieldwork phase, a new site, 4-SBr-5267, was discovered north of 4-SBr-4966 (Vaughan 1984:61-64). As the site was not included in either the original budget and schedule or research design, work at the site was limited to surface collection of a small sample of tools and debitage from ten clusters, or loci, of tool concentrations (Vaughan 1984:62).

In addition to the discovery of 4-SBr-5267, the 1983 fieldwork determined that cultural materials extended far beyond the mapped boundaries of 4-SBr-4969 (Robarchek et al. 1984; Vaughan 1984). The scope of the data recovery of 4-SBr-4969 was restricted, however, to that which was originally proposed (Vaughan 1984).

Following the field phase of the Nelson Wash data recovery, the present project included the analysis of the information and cultural materials recovered from the seven sites.

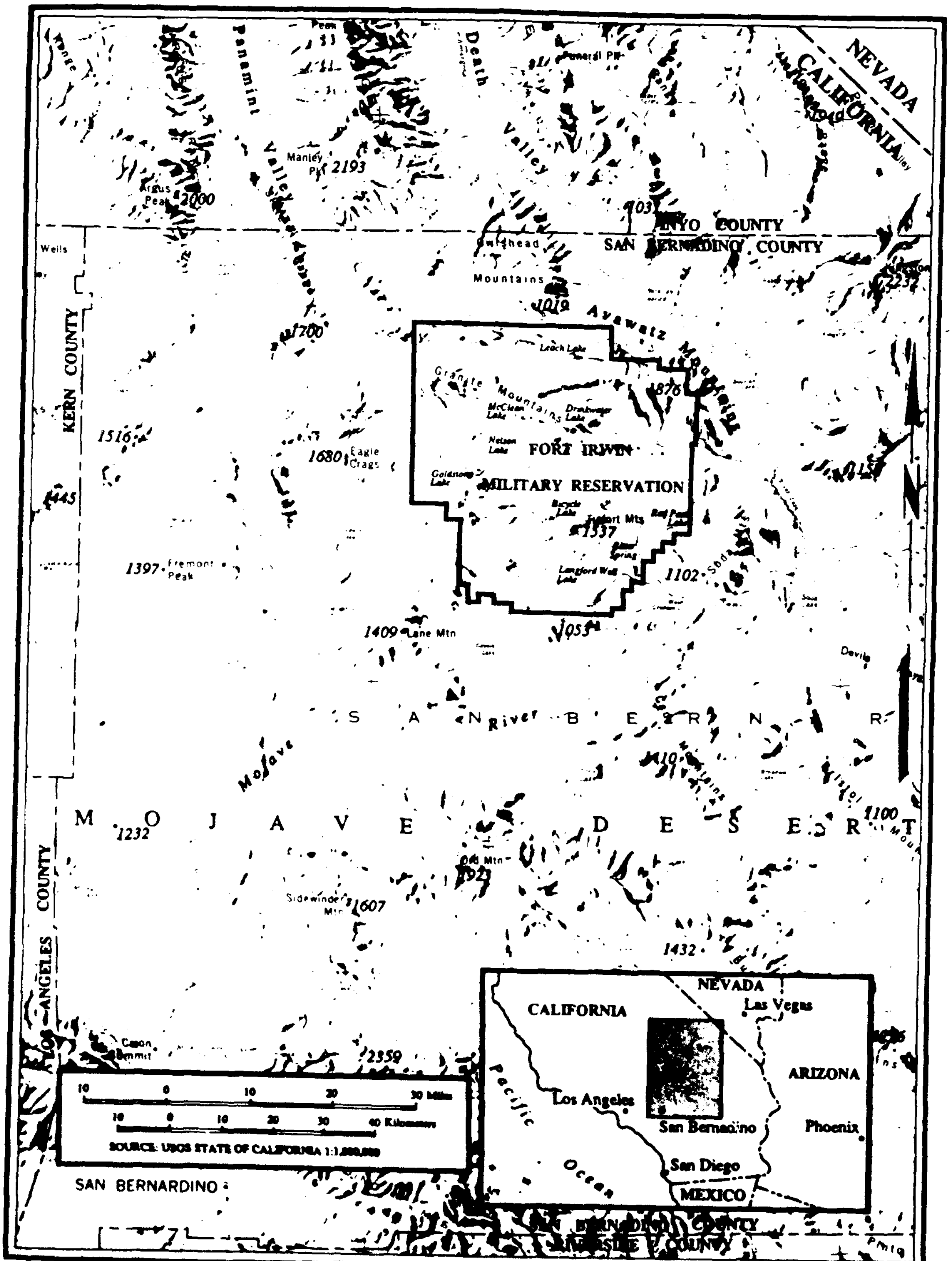


FIGURE 1-1. FORT IRWIN VICINITY MAP

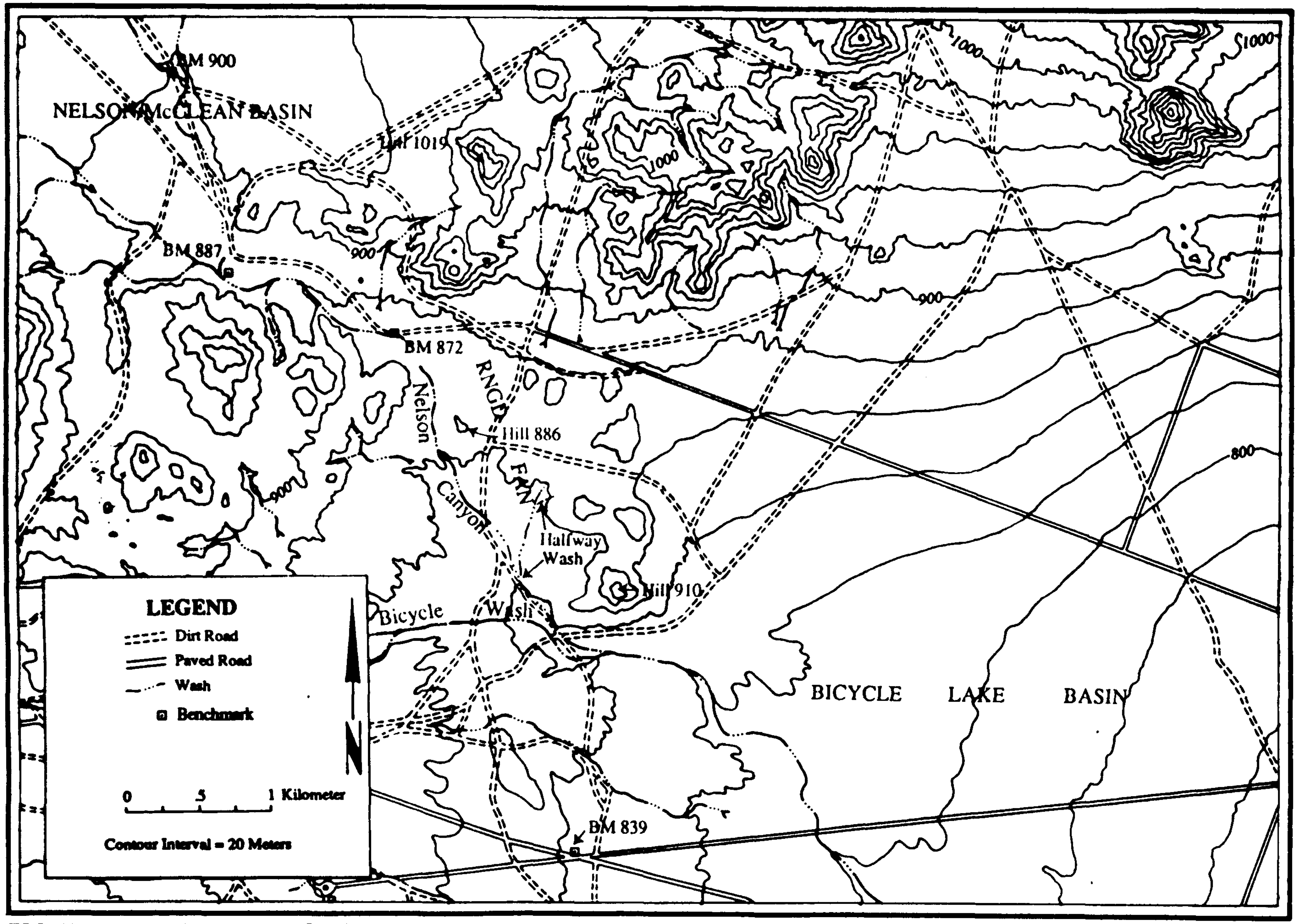


FIGURE 1-2. NELSON WASH STUDY AREA

RESEARCH DESIGN

The archaeological sites of Nelson Wash are viewed as a small part of a much larger assemblage of sites representing the Lake Mojave-Pinto cultural continuum of the central Mojave Desert (Figures 1-1 and 1-2). These are only seven of many sites recorded in the Nelson-Bicycle Lake Basin and they clearly contain artifact assemblages similar to others in the central Mojave. The Nelson-Bicycle Lake Basin is considered to have had two primary resource areas utilized by prehistoric man: lithic raw materials found in the Plio-Pleistocene detrital deposits, especially on the slopes south and east of Nelson Lake; and the riparian and lakeshore resources of Nelson, McLean and Bicycle lakes and connecting drainages. The use of these resources in prehistoric times has resulted in a number of different kinds of sites, the most common of which are lithic reduction locations and field or family camps.

The Plio-Pleistocene detrital deposits contain large clasts of basalt or metabasalt and lesser numbers of cryptocrystalline quartz nodules. These served as lithic resources for making chipped stone tools. Basalt and metabasalt are the most common materials found on lithic reduction locations, and these detrital deposits, covering more than 50 km^2, represent a major source for basalt in the central Mojave. Basalt reduction locations are thought to have been utilized primarily during the Lake Mojave and Pinto periods; at Fort Irwin metabasalt constitutes a large percentage (greater than 40%) of the detritus and bifaces from these periods, but only a small percentage (usually less than 10%) of the artifacts and flakes of the later periods.

Sites on topographic features associated with Nelson Lake and Nelson Wash contain finished tools and were apparently occupied while procuring and processing resources found nearby. In addition to lithic raw materials, plants and animals found in association with riparian and lakeshore communities and nearby mountain slopes were presumably taken. It appears that these sites, including the seven Nelson Wash sites, were occupied at a time when Nelson and McLean playas contained remnants of Pleistocene lakes in a small basin of approximately 225 km^2. For the lakes to have been maintained, the evaporation rates had to have been less, and/or the amount of local precipitation had to have been greater, than at present. The only periods

during which Nelson Lake could have provided a run-off or seepage into Nelson Wash were probably the Pleistocene and early Holocene. The Nelson Wash sites were occupied only so long as local plant and animal resources were abundant enough to support the human population. The increasing aridity of the Holocene is postulated to have reduced the productivity of these resources and placed increasing stress on the subsistence system of the Lake Mojave-Pinto cultural tradition.

The major thrust of the research reported here is an attempt to identify and explain the nature of the adjustments made by this early human population to the deteriorating resources. Unfortunately, the early cultural remains of the Mojave Desert are poorly suited for such research. An almost total lack of subsurface deposits is characteristic of sites of the Lake Mojave and Pinto periods. Consequently, on most sites only stone tools are preserved and their spatial relationships are often the result of post-depositional factors. The Nelson Wash sites are more or less typical of these conditions except for the Henwood site[1] (4-SBr-4966). This site has subsurface deposits containing faunal remains, features and artifacts, providing the first opportunity to directly date a Lake Mojave-Pinto occupation by means of associated carbon. The archaeological remains by which to address the hypotheses outlined below, however, are scanty at best.

The Nelson Wash research design (Wirth et al. 1984: hereafter referred to as the Wirth Research Design) has evolved somewhat over the years since it was originally proposed. This introduction reviews the research questions and hypotheses of the Wirth Research Design and discusses the additions and changes that have been made. Identification and explanation of the adjustments of human populations to the deteriorating resources requires the prior establishment of chronological order of the archeological sequence. The problem of chronology and its place in the research was not discussed in the Wirth Research Design, but it is important to the

[1] The author believes that any important site should be designated by a name as well as the long, easily confused site number. Site 4-SBr-4966 is, therefore, named the Henwood Site after Colonel William T. Henwood, whose cooperation, valuable assistance and advice during the project is most appreciated.

interpretation of later chapters of this report, where it is discussed in some detail.

The research design for the Nelson Wash sites is based on two models: a) the chronological/interpretive model of central Mojave Desert prehistory, and b) the Subsistence Focus Model to explain changes observed. The Subsistence Focus Model is abstract and theoretical; whereas, the chronological/interpretive model is inferred from empirical archeological and environmental data, as well as deduced from the subsistence mode. It is important to note that the appropriateness of the hypotheses derived from this subsistence model is dependent upon the validity of the chronological/interpretive model of prehistory and the adequacy of the data collected. This is most apparent in two basic assertions incorporated in the chronological/interpretive model: 1) the Lake Mojave and Pinto periods cultural manifestations represent a single, direct cultural development, a single cultural tradition; and 2) the major culture changes that occur during this development are directly or indirectly the result of adaptation to increasing aridity.

The assertion that the Lake Mojave and Pinto Period cultural manifestations represent a single cultural tradition implies that the assemblages will exhibit a chronological continuum and a high degree of cultural continuity. These implications are treated as hypothetical statements in Chapter 9 and require careful consideration of the chronological data. The Wirth Research Design (Wirth et al. 1984:6) recognized the importance of the chronological data and called for use of radiocarbon, obsidian hydration and stratigraphic dating together with cross-dating by use of known time-sensitive artifact types. The chronological data are organized and analyzed along these lines in Chapter 9.

Assertion 2 is addressed by Hypothesis 1 and 2 of the Wirth Research Design (Wirth et al. 1984:2).

> Hypothesis 1: The time of late Lake Mojave through Pinto periods was one of declining effective moisture.
>
> Test Expectations: Climatic and environmental data from along Nelson Wash will

indicate a decrease in shrubs and grasses, and reduced stream flow.

Hypothesis 2: The local artiodactyl population decreased during the late Lake Mojave Period through the Pinto Period.

Test Expectations: The number of artiodactyl bones relative to small animal bones will be greater in Lake Mojave component than in Pinto components.

Environmental data of various kinds are needed to test these hypotheses, as recognized in the Wirth Research Design (1984:6). Collection and analysis of faunal remains, pollen, and soil samples were made and reported herein. The results of these analyses were disappointing due to the limited quantity of data recovered and were insufficient for testing Hypothesis 1 above. (The description of the fauna, soils and pollen recovered from the Nelson Wash sites are found in the appropriate chapters and appendices). In Chapter 10, there is a discussion of data gathered throughout the Mojave Desert that supports Hypothesis 1. Hypothesis 2 is incorporated in the analysis reported in Chapter 10 and although the wording is slightly different, it appears as it appears as Hypothesis 1.

Hypotheses 3 through 6 of the Wirth Research Design are the equivalent to Hypotheses 2 through 5 in Chapter 10 of this report. In each case the wording has been changed in order to clarify and correct the earlier versions. Hypotheses 2 through 5 in Chapter 10 are arranged to test a sequence of changes in technology that are predicted on the basis of the Subsistence Focus Model. These hypotheses require data from areas of morphological and functional variability of artifact classes and correlations between this variability and changes in the faunal remains. For example, Hypotheses 2 and 3 require information on the variability of projectile point types and attribute associations and the relationship of these data to the changing frequencies of artiodactyl remains.

These kinds of analyses require that the artifact categories reflect morphological and functional attributes. The Wirth Research Design (1984:7-9) suggests that this is best done by developing a typology that takes into account morphology, technology and function. The artifact analysis in Chapters 4 and 5 present the artifact typologies and some functional interpretations. In most

cases, it is difficult to separate the attributes on the basis of function, morphology and technology. There are simply too many interdependent attributes crossing these divisions. In Chapters 7 and 8, however, these criteria and their spatial distribution are central to the assemblage composition and analyses.

Hypotheses 7 and 8 of the Wirth Research Design (Wirth et al. 1984:5) are not directly addressed in the text of this report. These hypotheses are:

> Hypothesis 7: There was no fundamental change in community organization from late Lake Mojave to early Pinto times.
>
> Test Expectations: 1) The size of individual components and the materials they contain will be consistent with that of small groups of foragers.
> 2) The variation in size and quantity of material in components will not exhibit a temporal trend; that is, it will neither increase nor decrease through time, but will simply vary about a mean.
>
> Hypothesis 8: With increasing aridity, fewer locations were suited to serve as residential bases for the hunting foragers of the late Lake Mojave and Pinto periods.
>
> Test Expectations: 4-SBr-4966, situated in the best watered stretch of Nelson Wash, was used later, or more often, in the early Pinto Period than other sites along the Wash. The other six sites were used less frequently in early Pinto times than they had been in the late Lake Mojave Period.

Chapter 10 discusses the settlement patterns from the perspective of the Central Mojave Desert and, while not a scientific test of either, these hypotheses, can be viewed as a "lawyer brief" arguing in support of both hypotheses. Hypothesis 7 cannot be adequately tested with existing information. "Components," as recognized by archaeologists, may result from a single or multiple occupation, different sized groups occupying the site, different durations of occupation, and differences in post-depositional disturbances. The Nelson Wash sites vary greatly in size, but each of them may be subdivided into smaller units based on concentrationsof material. If we consider the smaller units based on artifact concentrations as the basic site unit, then the components are all small in size suggesting a continuous use of the Nelson Wash sites by small foraging groups.

Test Expectation 1 of Hypothesis 7 is discussed in Chapter 10, but the data are inconclusive. The variability of assemblages addressed in Test Expectation 2 of Hypothesis 7 cannot be tested at this time. Most samples are so small that their variability reflects a close relationship with their size, as illustrated in Chapter 9.

Hypothesis 8 appears to be only weakly supported by the data from Nelson Wash. Five of seven occupation sites dating between 8200 and 6300 BC (Class 1 sites) are located near the confluence of Nelson and Bicycle Washes, and eight of 10 sites dating between 6200 and 4200 BC are similarly located at the confluence of the two washes. This only weakly suggests that later sites are slightly more concentrated near the confluence of the stream where water was probably more plentiful. These data suggest that there may not have been a significant reduction in number of social units utilizing this area until the later part of the occupation recorded in this report.

It should be recognized that the Nelson Wash research was designed as part of a much larger "Early Times Research Plan" for Fort Irwin (Warren et al. 1986), and the hypotheses presented in Chapter 10 are to be considered within this larger frame of reference. These hypotheses were in fact developed in conjunction with this broader research design and its proposed application to several Lake Mojave and Pinto period sites on Fort Irwin. A part of this research design is a search for early sites containing buried cultural material. The Henwoood site (4-SBr-4966) in Nelson Drainage, the Awl site (4-SBr-4562) at the west end of Drinkwater Basin, the Basalt site (4-SBr-4501) in No Name West Basin, and Rogers Ridge (4-SBr-5250) in Tiefort Basin contain such deposits. The Nelson Lake site (4-SBr-2356) at Nelson Lake also contained comparable data, but results of recent testing and evaluation are not yet available. The research design for the Henwood site and other Nelson Wash sites is the first test of the hypotheses derived from the Early Times Research Plan (Warren et al. 1986) and should be viewed as a step toward futher development of the hypotheses and data that will address the primary questions concerning the adaptations of early man to the deteriorating environment of the central Mojave Desert during the early to middle Holocene.

One aspect of the Early Times Research Plan, not available at this stage of fieldwork and

analysis, are the paleoenvironmental studies. The two most obvious kinds of studies so far undertaken are the analyses of pollen and faunal remains. Pollen analysis has not been generally successful due to the post-depositional environment that has destroyed much of the pollen in the archaeological sites. The highly organic deposits in which pollen is best preserved have not been sampled on Fort Irwin.

Faunal remains occur in the buried deposits of these early sites and some of the data are presented in this report. Faunal assemblages from archaeological sites present two major problems for the archaeologist: (1) they represent a biased sample of the local fauna selected by the prehistoric occupants of the site; and (2) the assemblages recovered from early sites on Fort Irwin are in highly fragmented condition, apparently resulting from both cultural and post-depositional factors.

A third type of paleoenvironmental study, macrofossil analysis of packrat middens, has resulted in large quantities of data relevant to the climate and environment (e.g. Spaulding et al. 1983) of the late Pleistocene in the Mojave Desert. The analysis of packrat middens should be a significant element in the paleoecological studies at Fort Irwin and an initial survey and recovery of packrat middens for analysis promises productive results.

These data suggest that at the time of occupation, the biotic communities of the Nelson-Bicycle Lake basins included some elements characteristic of modern arid environments, and that the model of late Pleistocene-early Holocene environment which simply depicts lowered elevation of modern biotic communities is no longer viable. The structure of hypotheses presented by Warren and others (1986) as well as the test of those hypotheses are often dependent upon a reconstructed model of past environments. Consequently, where paleoenvironmental studies are inadequate so must be the tests of the hypotheses.

The two models of the research design require adequate data to address their validity. The validity of the chronological/interpretive model of prehistory implies that the initial occurrence of the Pinto point series (marking the beginning of the Pinto Period) is correlated with the

desiccation of the Pleistocene lakes in the central Mojave Desert. These two events are placed chronologically at 5000 B.C. It should be obvious that: (1) all Pleistocene lakes in the central Mojave did not dry up simultaneously; (2) the 5000 B.C. date, therefore, is an "average" date, with some lakes persisting later in time while others were desiccated at an earlier date; (3) the 5000 B.C. date could be in error by as much as a millenium or more; and (4) Pinto points may occur earlier or later than the desiccation of the lakes.

Although problems of absolute and relative dating do exist, a general trend of increasing aridity does characterize the Lake Mojave and Pinto periods. Also, it is clear that the initial occurrence of Pinto points is later than the initial occurrence of Lake Mojave points and there are reasons to believe that the two periods are chronological divisions of a single cultural tradition. The basic tenet that there was directional change in environmental conditions and in cultural assemblages over the long time span represented by the Lake Mojave and Pinto periods appears valid. The subsistance focus model predicts relative sequences of events given certain conditions. Absolute dating is not required for testing these hypotheses. The environmental phenomena predicted on the basis of increasing aridity (e.g. critical decrease in artiodactyl population) cannot be equated with a particular period. That is, artiodactyl procurement may have reached a critically low level during either the Lake Mojave or the Pinto period. The subsistence focus model predicts the cultural response to that reduction. The chronological/interpretive model of prehistory predicts, for instance, a decrease in artiodactyl productivity at about the time of transition between the Lake Mojave and Pinto periods. If the decrease in artiodactyl production occurs during the Lake Mojave period or later during the Pinto period, the hypotheses deduced from the subsistence focus model can still be tested, even though the chronological/interpretive model is not supported. In short, inaccuracies or errors in the chronological/interpretive model of prehistory do not necessarily negate hypotheses deduced from the subsistence focus model.

The most critical assertion of the chronological/interpretive model is that the subsistence focus during the Lake Mojave period was artiodactyl hunting. This is based on scant data from sites of the Western Pluvial Lakes Tradition and the assumption that large mammal hunting was

generally the subsistence focus during the late Pleistocene and early Holocene throughout the North American continent. If artiodactyl hunting is not the subsistence focus during the Lake Mojave period, the hypotheses deduced from the subsistence model will be inappropriate and should not be supported by data from the Nelson Wash sites. The hypotheses will be rejected because they are inappropriate and the subsistence focus model will have remained untested.

Another basic postulate of the research at the Nelson Wash sites is that the Pinto Basin complex resulted from the adaptations of the Lake Mojave complex to the increasing aridity of the Mojave Desert. This assumes that the Pinto Basin and the Lake Mojave complexes are expressions of a single cultural tradition. There is, at this writing, no agreement among Mojave Desert archaeologists on this point. A tradition model for the Lake Mojave-Pinto Basin sequence, however, is an integral part of the research design for Fort Irwin. The data recovered from the Nelson Wash sites provide an opportunity to test the validity of continuity in the Lake Mojave-Pinto Basin cultural tradition. This cultural tradition model implies a continuity of cultural assemblage as well as occupation. Cultural continuity, however, does not imply lack of cultural change. A cultural tradition is marked by continuous and more or less gradual changes in artifact morphology, technology, and assemblage composition. The changes that occur can best be explained by adjustments and adaptations of the pre-existing cultural assemblage. When a cultural tradition is absent or disrupted, the disruption is marked by a series of changes over a short period of time that cannot readily be explained by internal adjustments and adaptations of pre-existing cultural assemblage.

The tradition model of the Lake Mojave-Pinto Basin sequence implies that the characteristic that distinguishes the Lake Mojave period from the Pinto period is the addition of the Pinto point series. If the tradition model is valid, other artifact types present at the time of the introduction of the Pinto point series will continue for undetermined periods of time. A gradual transition from one artifact assemblage to the other is predicted. The means by which the validity of the Lake Mojave-Pinto Basin tradition is determined relies on a series of five hypothetical statements that may be tested (see Chapter 9).

Settlement and subsistence data are not included in the test of the tradition model because the changes in environmental conditions during the Lake Mojave and Pinto periods were viewed as extreme and almost certainly would have resulted in changes in the settlement and subsistence system regardless of the presence or absence of the cultural tradition. These environmental changes induced changes in the technology, and reduced the likelihood of a cultural tradition being identified; therefore, affirmation of technological continuity is strong evidence for a cultural tradition in this instance.

Verification of the tradition model of the Lake Mojave-Pinto Basin sequence provides a basis for an examination of changing subsistence systems and settlement patterns. Substantiation of the tradition model eliminates the possibility of strong external cultural forces (e.g. movements of other cultural groups into the area) by which changes in subsistence and settlement pattern might be explained. With the removal of these external forces of change we must look to the dynamics of the cultural systems of the Lake Mojave and Pinto periods, and their interaction with a dynamic environment and changes in human demography.

Subsistence change in the Lake Mojave and Pinto periods is viewed against the theoretical subsistence focus model (Warren et al. 1986). The model presented in summary form in Chapter 10, argues that the process of focusing causes a limited portion of the subsistence system (a production set) to more readily undergo change. Because conscious manipulation of, and experiment with, this production set (or subsistence focus) is valued, it more readily undergoes change than other production sets that express a more conservative value toward change. By combining this concept of subsistence focus with an economic least-cost model changes can be predicted under given conditions. This model is discussed and hypotheses tested in Chapter 10.

Finally, it is recognized that the changing environment and subsistence adaptations will affect the settlement patterns of the early occupants of the central Mojave. This problem is examined in relation to the subsistence changes in the latter half of Chapter 10.

This study examines the cultural adaptation of the early occupants of the Mojave Desert to the increasing aridity of the early to middle Holocene. The subsistence focus model together with the chronological/interpretive model of prehistory form the frame work for this examination. The approach provides a means of examining a wide scope of cultural-ecological problems, and has resulted in a number of new hypotheses and stimulated additional questions.

CHAPTER 2 - SURFICIAL GEOLOGY OF THE NELSON WASH STUDY AREA

The Nelson Wash study area is located in the Mojave Desert in San Bernardino County, California, on the Fort Irwin Military Reservation. The dominant geomorphic feature in Nelson Canyon is a wide sinuous ephemeral stream channel known as Nelson Wash. All but one of the archaeological sites in this study are located on a high terrace overlooking the modern Nelson Wash floodplain. The exception, site 4-SBr-4969, is located east of the canyon on alluvial fan deposits in the Bicycle Lake Basin. Nelson Canyon is shallow and entrenched through low hills that separate the Nelson/McLean Basin from Bicycle Lake Basin (Fig 1-2). The canyon begins on the southeasterly margin of Nelson/McLean Basin and ends where Nelson Wash flows into Bicycle Wash (Fig. 1-2). The canyon is bound by low ridges that have been dissected into series of hills from 20 to 100 m high. The canyon width ranges from 1 to 3 km, and is narrowest at the northwestern end of the study area and the widest at the southeastern end.

NELSON WASH

Today, Nelson Wash is an ephemeral stream channel that discharges only following heavy rainstorms. It appears, however, that Nelson Wash had a much higher annual discharge that eroded channels and laid down fluvial deposits at various times in the Quaternary. Periods of greatly increased discharge may have resulted from a combination of factors: pluvial lake overflow from the Nelson/McLean Basin, increased groundwater seepage, or an increase in surface runoff within the Nelson Wash drainage area itself. All three of these potential contributors to increased surface flow through Nelson Wash require a dramatic increase in effective moisture over the existing arid conditions.

Beginning at about benchmark (BM) 900 (Fig. 1-2) the Nelson Wash channel rapidly becomes entrenched in an old sequence of stream deposits. As Nelson Wash enters the study area it flows south-southeast. Just past BM 887 it is deflected sharply to the east at almost a right angle. From here it flows almost due east to the toe of the RNGD fan, the apex of which lies at the mouth of a narrow canyon leading from the Nelson/McLean basin. After meeting the

RNGD fan, the Nelson Wash channel swings sharply to the southeast past site 4-SBr-4966 to Bicycle Lake Wash (Fig. 1-2).

As Nelson Wash cut its canyon it left a series of rock platforms and sedimentary terraces. The highest terraces have been incised into adjacent bedrock and are little more than truncated ends of ridges that extend into the canyon. Locus A of site 4-SBr-4966 and all of SBr-4965 are situated on such bedrock terraces. Beyond the fact that these appear to be old they are unremarkable and are probably not significant to the cultural history of Nelson Wash.

Sites 4-SBr-4965, 4-SBr-4963, 4-SBr-4966 (excluding Locus A) and 4-SBr-4967 are located on the highest sedimentary terrace lying 5 to 8m above the modern floodplain. This terrace is situated at a maximum elevation of 855 m near the head of the canyon, 500 m south of BM 900, and at a minimum elevation of 843 m near the mouth of the canyon. A small segment of this terrace is isolated on the south side of the channel near BM 887 and another near BM 872. The terrace has also been cut by the eastern Nelson Wash channel leaving a small remnant just south of Hill 886. A few less well-defined and more discontinuous terraces are situated along the channel in the study area. These range from a few centimeters to a few meters high. Most do not have associated archaeological material. Cultural material was found on one, Locus I of 4-SBr-4966.

Three stratigraphic units are recognized in Nelson Canyon, and are described on the basis of their exposure at the Henwood site (4-SBr-4966). The oldest unit described at the Henwood site contains both alluvial and fluvial facies. Cultural material was found on but not in this unit (Unit C), and on and in younger alluvial sediments comprising units A and B. Units A and B can be easily distinguished from Unit C by differences in clast rounding and lithology. The alluvial sediments contain gravel and cobbles that are angular and composed of metamorphic and granitic rock derived from the surrounding hills. The gravel and cobbles of the fluvial facies of Unit C are round to subround and some are of volcanic rock probably derived from volcanic outcrops on the southern margin of the Nelson-McLean Basin (Fig. 2-1). Correlations between exposures were made on the basis of physical similarity and stratigraphic and geographic

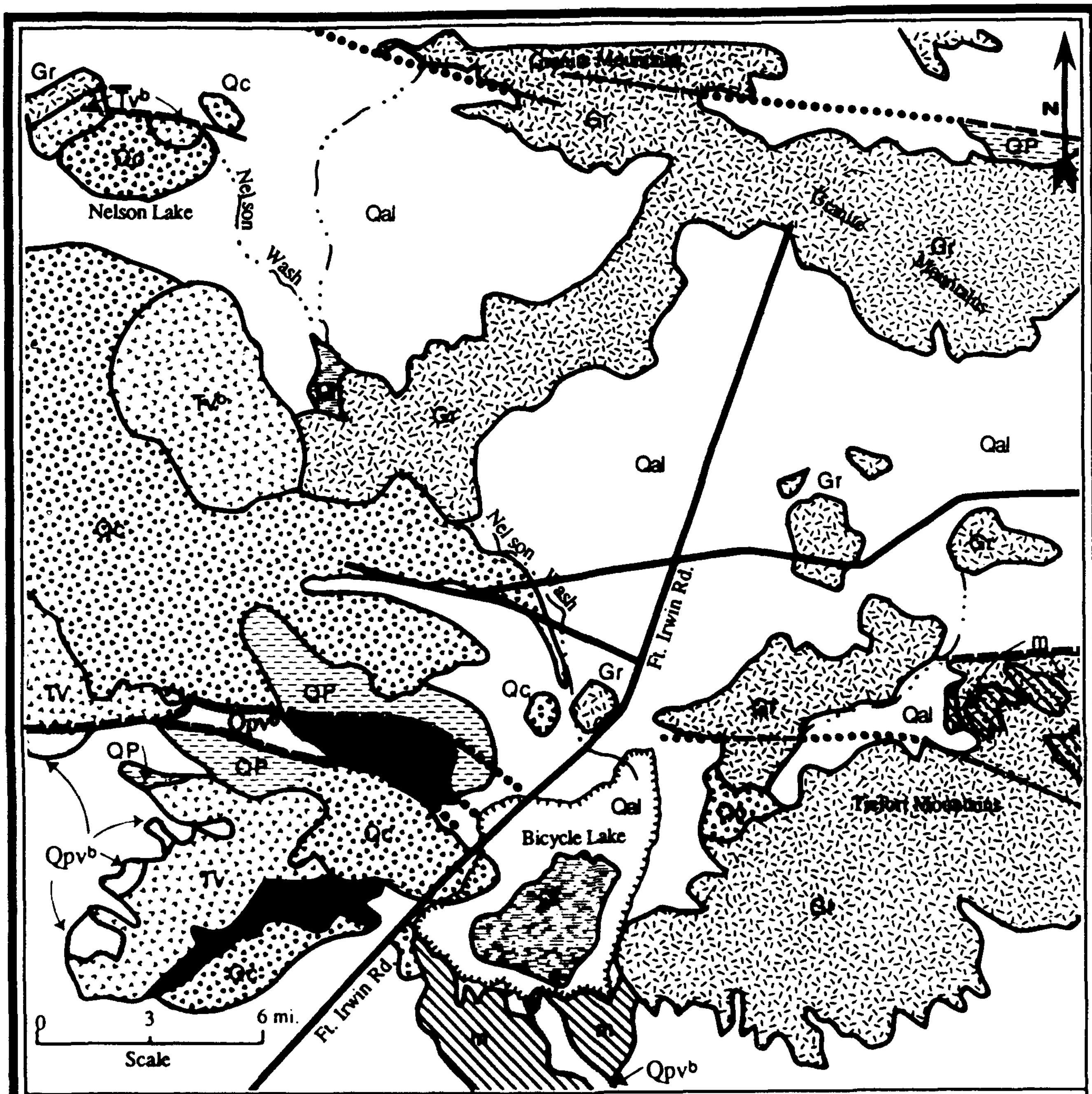


FIGURE 2.1. GEOLOGIC MAP OF THE NELSON WASH REGION

Pleistocene Nonmarine

Plio-Pleistocene Nonmarine

Quaternary Alluvium

Quaternary Lake Deposits

Tertiary Volcanics

Tertiary Volcanics-basalt

Mesozoic granites, & metamorphosed granitics

Pre-Cenozoic granitics and metamorphics

Pre-Cretaceous metamorphics

Pyroclastic Rocks

Faults

position. Physical continuity between strata was rarely evident because the exposures were isolated to individual excavations units, groups of excavation units, or unconnected trenches.

While the surficial geology of each site is briefly discussed, only the Henwood site provided ecure evidence of cultural materials in stratigraphic context. Therefore description of the soils and relevant sedimentary units are restricted to that site. The sediments on the western two-thirds of the Henwood site and all of site 4-SBr-5267 were deposited in an alluvial fan environment at the toe of the RNDG fan (Fig. 1-2). The sediments of an alluvial fan are a complex, reflecting cut and fill episodes associated with local precipitation. Deposition at the toe of the RNGD fan has been influenced by the aggradation and degradation of Nelson Wash which causes base level changes in the streams flowing across the fan. The alluvial fan sediments on the Henwood site are primarily composed of fine-grained gruss that contains small channel cut and fill structures. The alluvial sediments have undergone a sequence of soil development. A major erosional episode occurred after the deposition of Unit C and prior to the occupation of the Henwood site. The toe of this fan is truncated north of Hill 866 by the eastern channel of Nelson Wash. Stream channels, cutting headward up the fan from the Nelson Wash terrace, have exhumed ancient channels of Nelson Wash, and also have cut off the central part of the RNGD fan as a source of the sediment for the Henwood site (4-SBr-4966) area.

<u>Site 4-SBr-4965</u>

Site 4-SBr-4965 lies near the head of Nelson Canyon on the periphery of the Nelson/McLean Basin at 893 m. The site is situated on a sedimentary terrace at the base of a 7m high isolated schist outcrop. This outcrop is roughly circular in plan view, about 140 m in diameter and has a slope that does not exceed 7 degrees. The sediments of site 4-SBr-4965 are best observed at an exposure located 18-20 m south of the north end of trench 1. The surface of the site is covered by subrounded to rounded discoidal and spherical volcanic gravel in a sand matrix. A thin soil is devoloped on a cambric B horizon which are similar to Soil 1 and Sedimentary Unit C found at the Henwood site (4-SBr-4966) discussed below.

The vegetation on the site consists of species typical of the creosote bush community. The flora is dominated by *Atriplex polycarpa* and *Ambrosia dumosa*. *Larrea tridentada* is less abundant and *Atriplex confertifolia*, *Thamnosma montana*, *Hymenoclea salsola* and *Lycium andersonii* are present but rare. Other than the dead remnants of *Amsinckia tesselata* and unidentified grasses, no annuals were seen on the site or during the course of the fieldwork.

Site 4-SBr-4963

Site 4-SBr-4963 is located 1100 m southeast of site 4-SBr-4965, within upper Nelson Canyon on a 7-8 m high stream terrace situated on the northern side of Nelson Wash at an elevation of 885 m. The terrace sediments grade laterally into alluvium derived from the adjacent bedrock at the canyon edge. The terrace edge of the site has been heavily dissected by short, steep drainage channels, leaving six short, wide, finger-like ridges and numerous smaller ones. The largest of these ridges is 20 m wide by 50 m long. Several shallow rills (<50 cm deep and 100 cm wide) drain the northern one-half of the site into the drainage system north of the site.

The low cliff face in the cut bank of Nelson Wash reveals an upper unit of well-sorted, small gravel and silty clay, deposited in a fluvial environment, capped by a sandy gravel unit containing many caliche laminae. This upper unit lies on a poorly sorted sand and gravel unit capped by a geosol. Below this is a third unit consist of reduced sandy silt overbank sediment. Cultural material is present in the upper few centimeters of the first stratum, but these artifacts were probably introduced by recent military maneuvers and encampment.

The vegetation on the site is dominated by the halophytic shrub *Atriplex polycarpa*. The vegetative structure on the terrace has almost certainly been affected by recent military activity. Some of the flatter areas of the site either are barren or have few small *A. polycarpa* shrubs. Greater species diversity is seen on the finger-like ridges at the terrace edge where *Larrea tridentada*, *Cassia armata*, *Hymenoclea salsola*, *Ambrosia dumosa*, *Ephedra nevadensis* and an unknown grass species occur. Many if not all of these species occurred on the site during the

initial archaeological reconnaissance of the locality (Robarchek et al. 1984:101, 103).

Site 4-SBr-4967

Site 4-SBr-4967 is situated at an elevation of 881 m on a bedrock knoll on the southern side of Nelson Wash, about 500 m west of BM 872. The outcrop, which juts out into the stream channel from the southern wall of the canyon, may be a stream-cut rock platform or a resistant erosional remnant. It lies at an elevation comparable to other rock platforms along the canyon. This knoll is the upstream anchor of a stream terrace similar both in composition and elevation to the terrace on which site 4-SBr-4963 is found. The knoll rises 10m above the modern Nelson Wash floodplain. This site has been severely impacted by military activity with about 40% of the surface disturbed and erosional channels developing at right angles to the wash. Metamorphic rocks, including gneiss, schist and chlorite schist, outcrop in several places on the knoll and the Nelson Wash terrace. The majority of the knoll surface is covered with a mantle of colluvium cannot be extensively described because no units were excavated on the site and no natural exposures are available for observations. An analogous knoll is found in Locus A of the Henwood site (4-SBr-4966).

The site has a mosaic of shrubs comprising a hillside variant of the creosote bush plant community. The number of species is higher here than on the FP-1 terrace sites. Winter flowering annuals were not present at the time that fieldwork was done. Plant species observed on the site include *Atriplex polycarpa, A. confertifolia, Larrea tridentada, Cassia armata, Krameria arvifolia, Lycium andersonii, Echinocatus polycephalus, Eriogonum umbaletum, Ephedra sp., Salazaria mexicana, Hymenoclea salsola, Grayia spinosa, Ambrosia dumosa, Opuntia basilaris, Eriogonum inflatum* and two unknown grass species.

Site 4-SBr-5267 (RNGD-1)

Site 4-SBr-5267 is located a 864 m elevation on the north side of Nelson Wash ca. 200 m northeast of Hill 886. It is situated on a 2 m high stream terrace formed on a resistant surface

at the toe of the RNGD fan when Nelson Wash flowed to the east of Hill 886 (Fig. 1-2). Today, most of the floodwater that pass down the channel flows on the western side of the hill, although the eastern channel is active during major flooding events. The surface exhibits an exhumed argillic soil possibly correlated with Soil 3 at the Henwood site discussed below. The surface is covered with an angular feldspar and quartz gravel- and cobble-sized lag. The southwesterly flowing ephemeral tributary stream channels, the largest of which is nearly 600 m long and 40 m wide at the mouth, have deposited alluvium between the base of the terrace and the modern Nelson Wash floodplain. Cultural material found on the site is distributed on the interfluvial ridge tops, which have been further subdivided by numerous small drainages. Eight major ridges range from about 225-450 m in length and 30 to 180 m in width.

The vegetation on the ridges is composed on only three shrub species. *Atriplex polycarpa* is the most common. There are lesser numbers of *Larrea tridentada* and *Ambrosia dumosa*. In addition, *Hymenoclea salsola* is found growing in the washes.

The Henwood Site (4-SBr-4966)

The Henwood site is situated on the east side of Nelson Wash, beginning ca. 200 m south-southeast of Hill 886 and extending down the wash to a point across from Bicycle Wash. It reaches the edge of the Nelson Wash, and extends eastward onto the RNGD alluvium to the base of Hill 910. The site is confined to an oval area, 440X1120 m, with its long axis oriented N180W. It is between 840 and 860 m elevation, immediately north of the confluence of Bicycle and Nelson washes, at the mouth of Nelson Canyon. The site is bounded on the east by two high metamorphosed granite hills (Fig. 1-2).

The Henwood site is situated on a terrace composed of fluvial sediments, largely mantled with alluvial fan material. Nelson Wash has downcut in the site vicinity, forming a 3-6 m high cut bank that marks the site's western boundary. A comparable terrace is found within the channel south of Hill 886 on which the cultural materials representing Locus I are found. Its composition and elevation are similar to the eastern terrace, on which the other loci of the site

are found. Shallow wash channels have cut into the site producing some relief. The longest of these, known herein as Halfway Wash, extends from the eastern edge of the site 550 m southwesterly across the site. It is only a few centimeters deep on the eastern edge of the site but has downcut to a maximum of 4 m where it intersects Nelson Wash. Several other, shorter channels have dissected the terrace along its length.

Alluvial deposits extend westward from the base of Hill 910 on the eastern side of the canyon. These deposits comprise about one-third of the site's surface and contain subsurface and surface cultural materials. They slope between 1 and 2 degrees due southwest. The sediment is a gravelly sandy loam that contains some cobbles, especially near the hills. The surface has been weakly sculptured by a number of northeast to southwest trending rills. These deposits do not extend to the edge of the Nelson Wash terrace, but grade into lighter colored fluvial sediment along the entire western one-third of the site.

The Henwood site lies on and in a complex of sediment and soil types. The postglacial (latest Wisconsin and Holocene) units and soils have been classified into two different types. A third sediment and soil type, upon which the postglacial sediments rest, is also recognized and described.

Soils of The Henwood Site

Soil 1 is a massive to occasionally weakly platy south of Halfway Wash, to often platy north of Halfway Wash. When dry its consistency is loose to weakly coherent. When wet, it is slightly sticky and non-plastic. It contains very few to locally abundant fine roots. It is best observed when developed on sedimentary Unit A (see below).

Soil 2 is an angular and blocky soil, slightly hard when dry. When wet it is slightly sticky to sticky and non-plastic to slightly plastic. Desiccation polygons are present in this soil, and the peds are prismatic, as large as 10 cm across, 15-20 cm deep, and are separated by 1-5 cm of interped sediments that contain less clay, silt, and calcium carbonate than the ped sediment. It

contains very few to locally abundant fine roots and has a strong to violent reaction to dilute HCI. Dry soil colors ranging from (commonly) pale brown and yellowish-brown (10YR7/3.5, 10YR5/6, and 10YR6/4) to (less frequently) pink (5YR7/3.5), to (rarely) reddish-yellow 95YR6/6, 7.5YR6/6, and 7.5YR7/6). This soil is developed on sedimentary Unit B.

Soil 3 is usually massive, rarely with a blocky, crumb structure. It is weakly coherent to slightly hard when dry, and slightly sticky to sticky and nonplastic to slightly plastic when wet. Caliche peds are occasionally present. Very few to locally abundant fine to coarse roots; roots are more common in this soil than in the ones above it. It possesses very few to many vesicles, usually within a ped. It has a strong to very strong reaction to dilute HCl. Larger clasts within this soil have a thin to thick carbonate rind; some carbonate root casts seen. Dry soil colors range from (commonly) light-yellowish brown and very pale brown (10YR6/4, 10yR7/4, and 10YR7/3) to (less frequently) yellowish brown (10YR5/4 and 10YR5/6), pale brown (10YR6/3), or grayish brown (10YR5/2). In Locus E, this soil is light brownish grey due to staining by charcoal, and it displays carbonate pods 10-15 cm thick and 30-50 cm long near the bottom of the soil, 40-50 cm below the surface. It is developed on sedimentary Unit C.

Sedimentary Units of the Henwood Site

Sedimentary Unit A is a reworked eolian sand with occasional gravel-sized clasts. It is discontinuous and less than or equal to 5 cm in thickness south of Halfway Wash. Facies of this unit north of the wash are a gravelly, loamy sand incorporating materials from the toe of the RNGD fan. Cobbles are rare. Gravels are predominantly angular metamorphic and granitic clasts less than o.5 cm in diameter. Channel fills and gravels are less frequent in Unit A than in the underlying Unit B. The lower contact of this unit is almost always abrupt and wavy. The estimated age of this unit is late-middle Holocene to late Holocene (6000 B.C. to recent).

Sedimentary Unit B is a gravelly, loamy sand to loamy, sandy gravel. It generally lacks the silt and clay content of the overlying Sedimentary Unit A and underlying Sedimentary Unit C. Cobbles are rare absent unless associated with a channel fill facies to the west of the site close

to Nelson Wash. Clasts are commonly of angular, metamorphic and granitic rock. The contact with the lower stratum (Unit C) is wavy to irregular and usually abrupt, often sculptured by rodent burrows. Evidence of rodent activity is rare elsewhere in the unit. Twenty-one channel fills were observed in this unit, 9 in the area bracketed by S1539-S1630 and E2080-E2153. The estimated age of this unit is latest Wisconsin to middle Holocene (10,000 to 4000 B.C.)

Sedimentary Unit C is a sandy, gravelly loam to loamy, sandy gravel. Cobbles are rare to absent. The east alluvial facies are manifest in the trench profiles with clasts that are primarily of angular metamorphic and granitic rock with rate rounded volcanic rock. To the west, closer to Nelson Wash, fluvial facies are common with clasts that are primarily of rounded volcanic rock. Crotovinas are common in upper meter of this unit. These consist of chambers as large as 70 cm high and 120 cm long, connected by tubular burrows 10 to 20 cm in diameter. The crotovinas are filled with massive sands and gravels that, in contrast to the surrounding sediment, are loose to weakly coherent with clasts that are commonly rounded. These in-filling sediments appear to be of fluvial origin. The lower contact is smooth to wavy and usually abrupt. The estimated age of this unit is Late Wisconsin or older (> 12,000 B.C.).

Site 4-SBr-4968

Site 4-SBr-4968 is located at the confluence of Nelson and Bicycle washes. It is just north of Bicycle Wash and about 200 m west of the Henwood site (SBr-4966) (Fig. 2-1). The high bank west of Nelson is situated on a 13 m high stream terrace incised into fluvial gravels. The terrace has been dissected into three long narrow interfluvial ridges, designated from north to south as loci C, A, and B. Locus C measures 85X40 m and is found near the end of a triangular ridge that is 300 m long by a maximum of 90 m wide. Locus A is 100X45m with a sinuous outline that follows the edge of a sinuous semi-oval ridge that is 250 m long by a maximum of 90 m wide. Locus B measures 125X35 m and is situated on an oval ridge that is 135 m long by 50 m wide. The terrace surface on which this site is located slopes at 1 to 2 degrees toward Nelson Wash.

The site vegetation contains elements belonging to the creosote bush community. The flora includes *Larrea tridentata, Ambrosia dumosa, Atriplex polycarpa, Atriplex confertifolia, Cassia armata, and Eriogonum inflatum.* Except for a few isolated creosote bushes, the desert pavement tends to be barren. Plant density and diversity increase on the ridge slopes.

Site 4-SBr-4969

Site 4-SBr-4969 is just east of Hill 910. The site lies on a broad alluvial plain that forms the toe of a large piedmont that has built out from the west along the axis of Bicycle Wash and coalesces with a fan forming from the hills to the north (Fig. 1-2). This piedmont contains cobble- and boulder-size clasts of black metabasalt as well as cobbles of cryptocrystalline materials. An enormous quantity of lithic refuse found on the fan surface indicates its use as a lithic source, or quarry in prehistoric times.

The surface of the alluvial plain has numerous southeast trending ephemeral stream channels that are usually less than 20 m wide and 1 m deep. The surface of the western part of the site is covered by a patinated gravel pavement composed of basalt, metabasalt, felsite and andesite and which includes patches of cobble- and boulder-size clasts. Most of the quarry activity found on the site appears to be associated with these patches. To the east the pavement does not occur, probably because this area is the relatively more active toe of the piedmont. Cobbles do occur in this area with apparently less frequency than the pavement to the west.

SUMMARY

The depositional history of Nelson Wash (Figure 2-1) is intimately related to events that have occurred in the Nelson/McLean Basin. Evidence of the existence of shallow lakes in this Nelson Basin during the Lake Mojave and Pinto periods has been described by Kaldenberg (1981). Some data suggest that people may have occupied the shorelines deposited by shallow lake fills of 1-2 m (interior strandline sequence) and 7 m (intermediate strandline sequence). Although neither strandline sequence nor the archaeological material are well dated, the archaeological

data and their relationship to the shoreline features suggest that the cultural material is no younger than mid-Holocene and no older than latest Wisconsin-early Holocene (Skinner 1985:225-291). While these lake stands could not have overflowed into Nelson Wash.

The groundwater table was higher than it is today during the time the interior and intermediate strandline sites were occupied. If there was a shallow lake in Nelson Basin, it follows that the water table would be correspondingly higher. Under this condition groundwater may have surfaced in Nelson Wash which lies 40-90 m. below the floor of Nelson Playa. Numerous springs may have discharged into the wash and at times an intermittent stream may have flowed.

Pre-Holocene fluvial sediments were deposited on an ancestral Nelson Wash floodplain and are preserved as fluvian facies of sedimentary Unit C at site 4-SBr-4966. These fluvial sediments interfinger with alluvium which was contemporaneously being deposited from the flanking hills to the north and east of the wash. Moreover, volcanic clasts in Unit C indicate a catchment area that included the Nelson/McLean Basin, where such rocks outcrop. With reduced annual stream discharge the Nelson Wash floodplain would have stabilized and Soil-3 would have formed.

Following the development of Soil-3, alluviation became the dominant geologic process in Nelson Wash. Portions of Unit-3 were truncated and it was unconformably covered by alluvial sediment, Units 1 and 2. The alluvial sediment of Unit-2 was deposited on the old floodplain surface as the RNGD fan toe moved west to the stream channel (Fig. 1-2). Unit-2 sediment probably built up gradually. At some point the system stablized and the Henwood site no longer received sediment from the RNGD fan. Pedogenic processes began to act on the sediment and Soil-2 formed. Soil moisture conditions were such that calcium carbonate, deposited in the upper 30 cm of the soil, formed carbonate pods. These tend to shrink as they dry forming narrow cracks that allow soil particles to migrate downward into the profile. This process is continuing at the present time.

Between 12,000 and 6,000 B.C. the climate underwent a slow transition from the cooler, moister conditions of the Late Wisconsin to the arid conditions of the Holocene. In the beginning of this

transitional period, vegetation was dominated by woodland "with some desert species like four wing salt bush, desert almond, Joshua tree, sagebrush and shadscale particularly common in these woodlands" (Spaulding, Leopold and Van Devender 1984:285). Other desert shrub vegetation began to invade the area prior to 13,000 B.C. and arboreal elements retreated upslope and to areas of more mesic soil conditions:

> In the Mojave Desert, woodland midden [*Neotoma*] records dating to the last part of the Late Wisconsin (ca. 15,000 to 10,000 B.P.) are from altitudes above 1000 m, from mesic sites, or from the vicinity of the trough of the Colorado River. Throughout most of the Mojave Desert the regional vegetation below ca. 1000 m altitude was probably a mosaic of desert scrub and woodland, varying in response to spatial and temporal changes in edaphic and climatic conditions (Spaulding 1983:263).

Creosote bush did not arrive in the area until after 8,000 B.C. and many species of large mammals became extinct by 9,000 B.C. (Spaulding, Leopold and Van Devender 1984:286).

Increased precipitation may have episodically filled Nelson, Bicycle and possibly McLean lakes during the early Holocene. The lakes were shallow and short term, disappearing in drier years. Lake levels fluctuated rapidly because of variation in precipitation, but the groundwater table remained higher than today. As a consequence, Nelson Lake was most stable at 1-2 m and a lakeside vegetation developed. The vegetation would have responded to the groundwater gradient, with cattail in the water, rushes along the shore, grasses and possibly trees on the shore where the soil was moist, and halophytic shrubs such as pickleweed, iodine bush, and saltbush in saline soil conditions. Fauna was locally enhanced and included migrating waterfowl. Springs emerged along Nelson Wash, topographically lower than Nelson Basin, supporting the same biotic community found along the Nelson Wash shoreline. The area was intensively utilized by man, attracted to the area by its mesic biotic resources.

Nelson Wash may have been at depositional equilibrium until the end of this period. In the vicinity of the Henwood site (4-SBr-4966), Soil 3 and older, case-hardened caliche soils retarded downcutting, causing the stream to meander across a broad shallow. In moist years a small

stream, fed by snow pack on the Granite Mountains, groundwater and winter precipitation, may have flowed in the channel. This intermittent stream would probably have flowed only during the spring but may have persisted year-round in some wet years. This stream filled large animal burrows in Unit-3 with sediment.

The alluvial sediments of Unit 2 underwent a complex aggradational episode during the occupation of the Henwood site (4-SBr-4966) perhaps caused in part by increased summer rains. The channels of the RNGD fan actively deposited sediment onto the Henwood site. Sediment from the eastern and middle channels of the RNGD fan coalesced across the Henwood site at the time Locus G was occupied. As downcutting in the eastern Nelson Wash channel progressed, It eventually captured the streams from the middle area of the RNGD fan as a source of alluvium, and the fan became a more dominant sediment any source on the Henwood site.

After ca. 6000 B.C. the climate was arid, with conditions approximating those of today. Rainfall was lower and mean annual temperatures higher than the preceding period. The Nelson Wash sites were largely abandoned since the water and vegetative resources that attracted people to the area were gone. The alluvial Sedimentary Unit B began to slowly erode and the tributary wash that dissected it gradually cut across the site. A thin accumulation of aeolian sand, Unit A, was deposited on the surface by prevailing westerly winds. Sheet wash moved sediment downslope where alluvium was mixed with this eolian sand.

CHAPTER 3 - METHODS OF DATA RECOVERY by Margaret M. Lyneis and Sheila A. Vaughan

Data recovery at the Nelson Wash sites required a variety of methods, including sampling and collection of surface assemblages, subsurface exploration with heavy equipment, and excavation. The general allocation of data recovery efforts was developed in the course of the proposal development for the project. Adjustments made during fieldwork are detailed in the preliminary report (Vaughan 1984). Here we describe what was done and why, so that the analysis of the materials recovered can be placed in context and evaluated.

Seven sites were addressed in the data recovery effort, six of them small sites with only surficial materials. The seventh, the Henwood site (4-SBr-4966), is a large, complex site with extensive surficial materials as well as some buried materials. Recovery of surface materials involved a basic suite of techniques, including pinflagging, selecting probability samples for collection with a 5X5 m grid, collecting judgmental samples with the same grid, shoveling and screening of the surficial zone of 1X1 m squares in selected 5X5 m units, and collecting additional tools with the establishment of provenience by transit. The particular mix of techniques for each surface site was determined in the field.

SMALL SITES DATA RECOVERY

The six small sites are on old, elevated surfaces. Five sites, 4-SBr-4963, 4-SBr-4965, 4-SBr-4967, 4-SBr-4968 and 4-SBr-5267, are located on the edge of Nelson Wash. The sixth, 4-SBr-4969, is a very large site well away from the washes margins, in patches of cobble-sized desert pavement. As data recovery was conducted upon only a small portion of this site, the description of the work is included here. None of the small sites had cultural features of any kind, so the information they provide is limited to the density and distribution of artifacts and debitage on a natural surface. In each case, the underlying deposits are of considerable antiquity and predate the deposition of artifacts. The geological situation does not provide for determining a chronological ordering or separation of the occupations, but the setting provides some clues as to why the occupations are found where they are and leads us to expect some variation in the kinds of materials that are recovered.

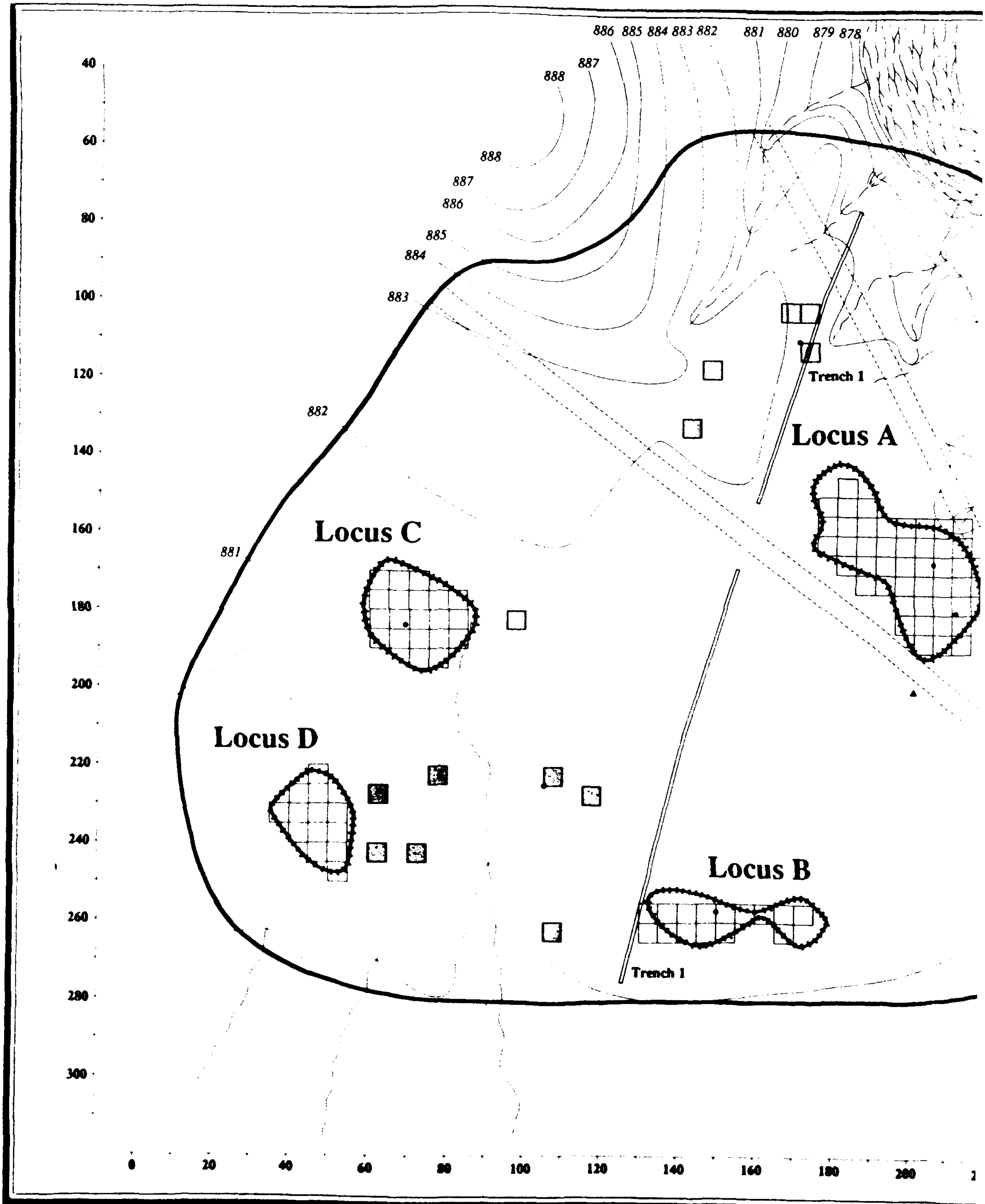
Site 4-SBr-4965

Site 4-SBr-4965 lies at the upper end of Nelson Wash Canyon on the periphery of Nelson Basin at an elevation of 893 m above mean sea level (amsl) (Figures 1-2 and 3-1). It is situated on an interfluvial ridge formed by the highest sedimentary terrace overlooking Nelson Drainage, at the base of a 7 m high isolated schist outcrop. The Nelson Drainage channel lies to the north of the site, but swings abruptly southward about 300 m east of it, truncating the ridge. The ridge is bounded on the south by a second ephemeral stream channel that drains the hills south of the site. The ridge is 450 m wide in the site's vicinity and extends 450 m to the west. Except near the edges of the terrace, it is flat, sloping at 1 degree 30 minutes to the south across the site.

During the initial survey, two artifact concentrations were identified (Robarchek et al. 1983:104-105). The northern area, designated Locus A, measures 50(E-W)X30(N-S) m and the southern area, designated Locus B, measures 15(N-S)X40(E-W) m. At that time no tools were observed in the southern locus and the flake concentration was described as more dispersed and less dense than the northern locus (Robarchek et al. 1983:105). Both areas together were thought to encompass approximately 7,884 m^2.

Military impacts were present at the site, particularly in the area of Locus A. Two jeep trails skirted the boundaries of this locus and may have disturbed sections of the flake concentration (Figure 3-1). The southern area of the site was fenced by the Army to protect the site from military activity; however, new tank trails were visible when the data recovery commenced in July, 1983.

Pinflagging of the site was performed by 13 persons spaced approximately 2 m apart. Transects were run northwest-southeast across the area. In addition to relocating the Locus A and Locus B artifact concentrations recorded during the initial survey, two other small loci (Locus C and Locus D) were identified farther to the west. Locus C is located 90 m west of Locus A, and Locus D is 80 m west of Locus B (Figure 3-1). The site area now measures approximately 170(N-S)X220(E-W) m, and encompasses approximately 50,100 m^2, much larger than the site



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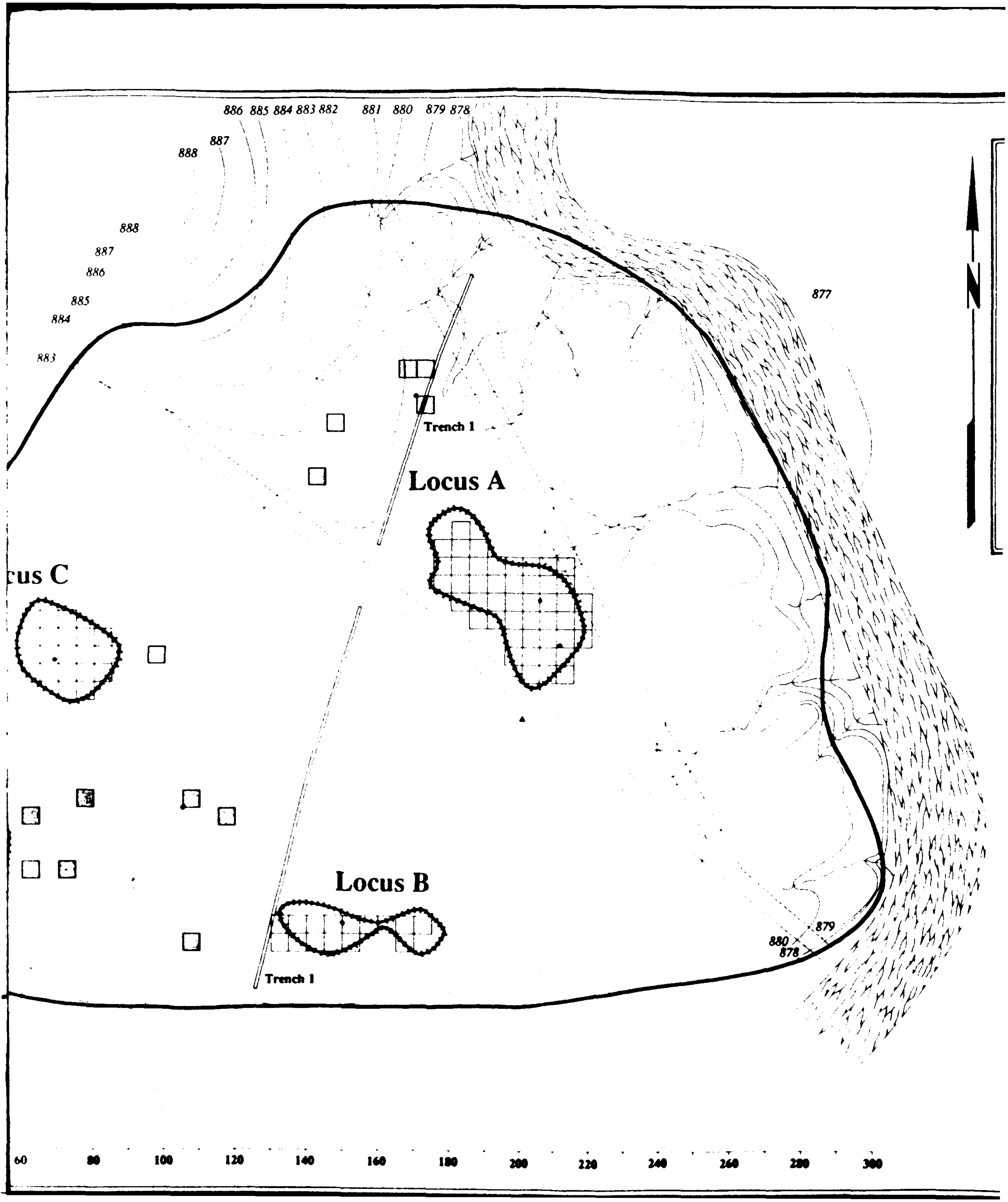

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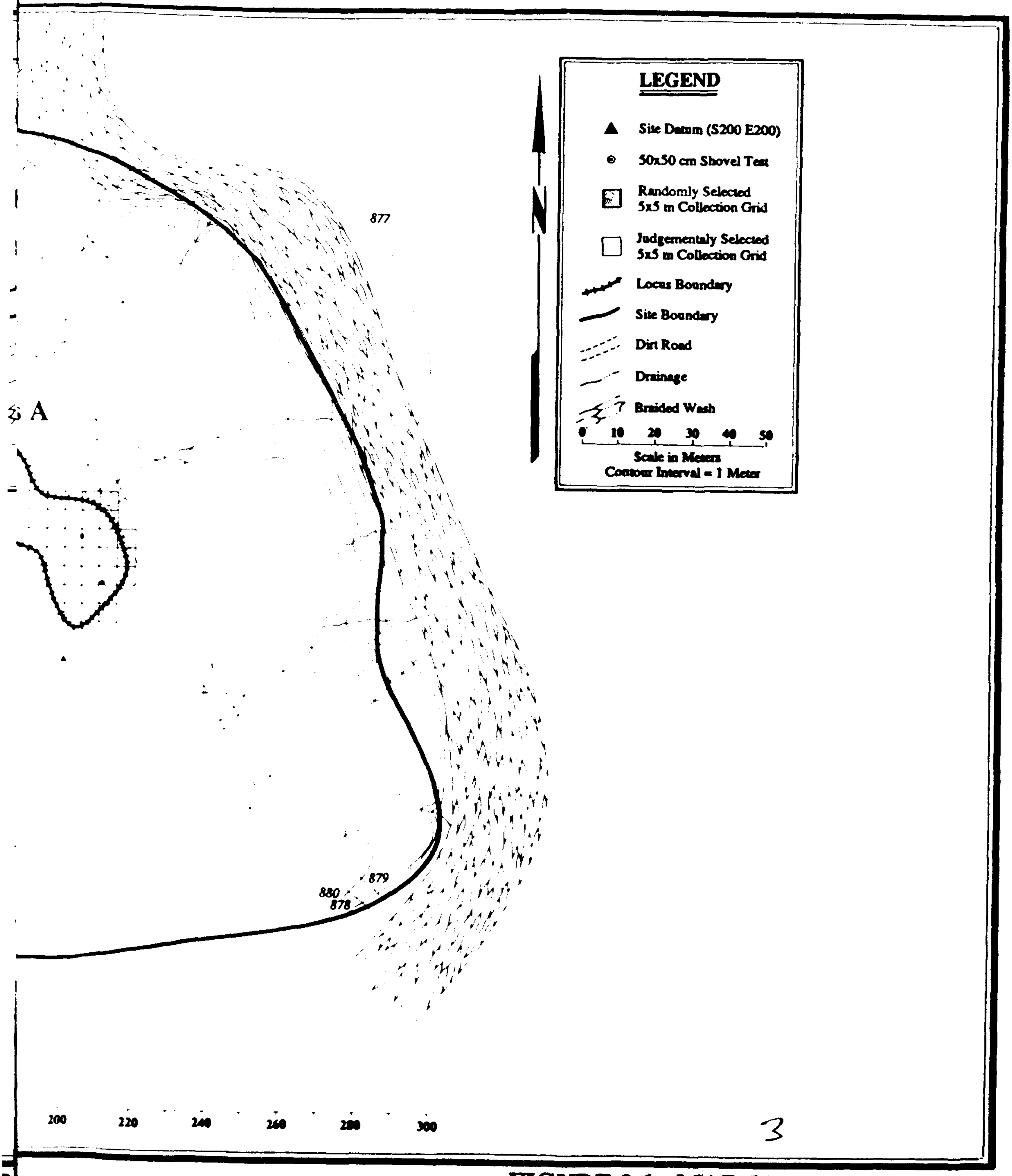

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FIGURE 3-1. MAP OF SITE 4-SBR-4965

area described in the original survey report (Robarchek et al. 1983). In addition to identifying loci of concentration of cultural debris, all formal artifacts noted on the surface of nonlocus areas were collected and their locations documented by transit. Eighteen additional tools were provenienced from the nonlocus area of the site.

The surface of each of the four loci was collected with the 5X5 m grid. Because the artifact density was low, the 5X5 m unit was used as the horizontal control and the material collected is provenienced to the 25 m^2. Approximately 100% of each locus was collected in this manner. Exceptions to this were areas of very low density of surface artifacts or areas near locus boundaries. Table 3-1 lists the area and the number of surface collection units for each locus, and the total number of debitage and tools recovered from site 4-SBr-4965 with the use of the 5X5 m grid.

Table 3-1: Results of Surface Collection at Site 4-SBr-4965.

Locus	Area (m^2)	5X5 m Units	Tools	Debitage
A	1,175	46	29	495
B	375	15	2	51
C	475	20	1	20
D	325	13	0	18
Nonlocus (south)	5,300	8	0	3
Nonlocus (north)	2,700	5	0	3
Total	10,350	107	32	590

Two other areas revealed low density artifact scatters, too dispersed to be considered loci. The southernmost of these (Figure 3-1) is bounded by Locus C and Locus D on the west and Locus B on the east. These limits were arbitrarily chosen, as were the northern and southern boundaries. The southern nonlocus area encompasses approximately 5,300 m^2. Eight 5X5 m collection grids were used to sample it, and these were randomly selected from the 212 5X5 m

units which comprise the area. The other low density area is located northwest of Locus A and covers approximately 2,700 m^2. From this northern nonlocus area, five 5X5 m collection units were randomly selected. As the table shows, very little surface material appears outside the loci boundaries. Because of this, only 107 surface collections units were collected from the site.

In an effort to determine the amount of surface material that may have been slightly buried, 1X1 m shovel scrapes were excavated to a depth of 3-5 cm below the ground surface in approximately one-half of the 5X5 m grids in the locus and nonlocus areas. Usually, the north-easternmost 1X1 m unit received the shovel scrape, but if this area was disturbed or covered by vegetation, another block was chosen. Those 5X5 m units receiving shovel scrapes were arbitrarily chosen. Usually, the field crew responsible for the surface collection was asked to shovel scrape every other 5X5 m grid that was collected. The number of shovel scrapes in the locus and nonlocus areas is given below (Table 3-2) with the amount and type of cultural material recovered.

Table 3-2: Results of Shovel Scrapes at Site 4-SBr-4965.

Locus	Number of Shovel Scrapes	Tools	Debitage
A	23	1	12
B	8	0	2
C	10	0	2
D	5	0	1
Nonlocus (south)	4	0	0
Nonlocus (north)	5	0	0
Total	55	1	17

The next phase of fieldwork was excavation to determine the presence and depth of subsurface cultural deposits. Since the site area showed such a widely dispersed surface scatter, eight 50X50

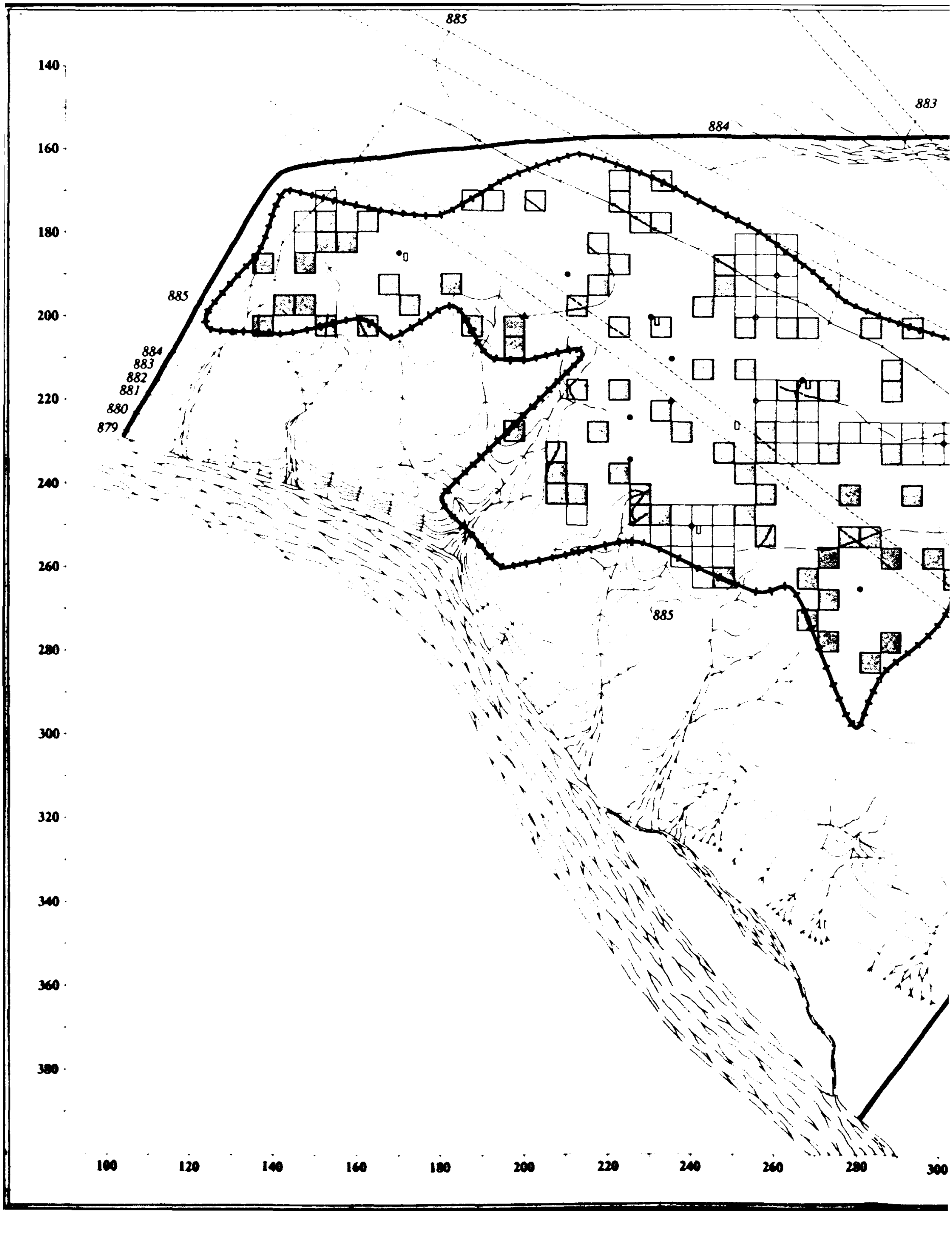
cm shovel tests were judgmentally placed in areas with the highest concentration of surface material and in the nonlocus areas (Figure 3-1). Three flakes were recovered to a 10 cm depth from one shovel test (S167 E205) in Locus A. This was the only cultural material present in the shovel tests. Thus, site 4-SBr-4965 shows little evidence of subsurface accumulation of cultural debris. No other controlled excavation appeared necessary to assess the presence of subsurface cultural deposits at 4-SBr-4965.

Although the shovel tests indicated that subsurface deposits were minimal at the site, additional subsurface exploration was accomplished through the use of heavy equipment at Locus A and Locus B. A backhoe with a 36-inch bucket was used to cut a trench approximately 240 m in length on a north-south axis (Figure 3-1). The trench bisected both Locus A and Locus B and extended to the northern and southern perimeters of the site. The depth of the cut varied depending on the resistance and type of substrata. Examination of the trench and the excavated soil for cultural features and artifacts confirmed the absence of subsurface cultural materials.

Artifacts are found on the surface of a soil of subround to round volcanic gravels in a sand matrix. The site was pinflagged to confirm its boundaries and estimate the density and distribution of the materials. The materials were almost entirely confined to the four loci, and there were no rocks or other features on the surface; the data are limited primarily to the distribution of tools and debitage.

Site 4-SBr-4963

Site 4-SBr-4963 is located within Nelson Wash Canyon, 1,100 m southeast of site 4-SBr-4965, where the wash is about 40 m wide. Like 4-SBr-4965, this site is situated on a 7-8 m high stream terrace (FP-1) on the northern side of Nelson Wash at an elevation of 885 m amsl (Figures 1-2 and 3-2). This terrace is a flat-topped area that begins at the head of the canyon, about 750 m northwest of the site and extends 1,100 m into the canyon, where it has been truncated by a meander of Nelson Wash. The site lies on an interfluvial ridge formed by a shallow (less than 2 m) drainage to the north that flows east along the terrace parallel to the



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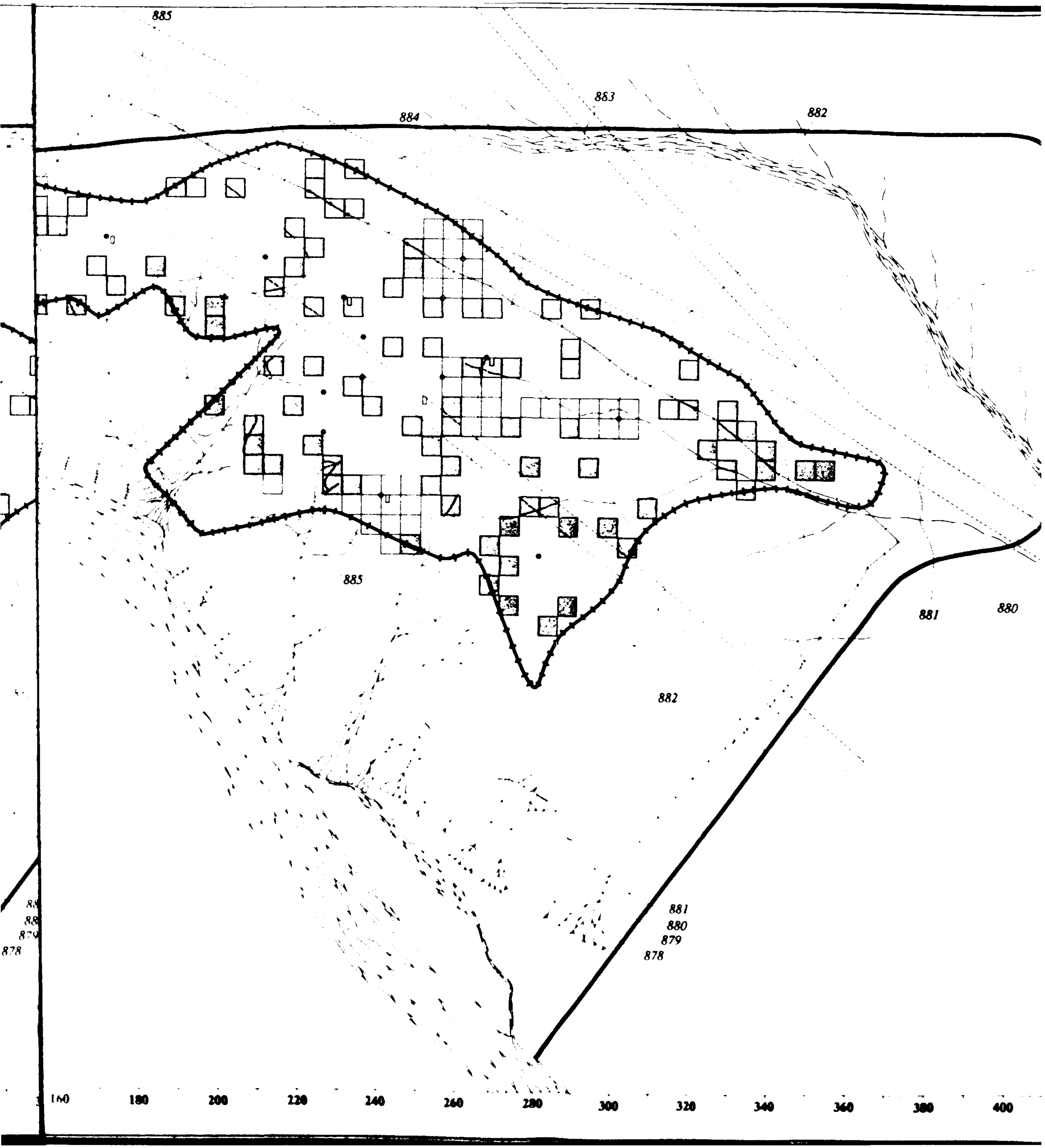
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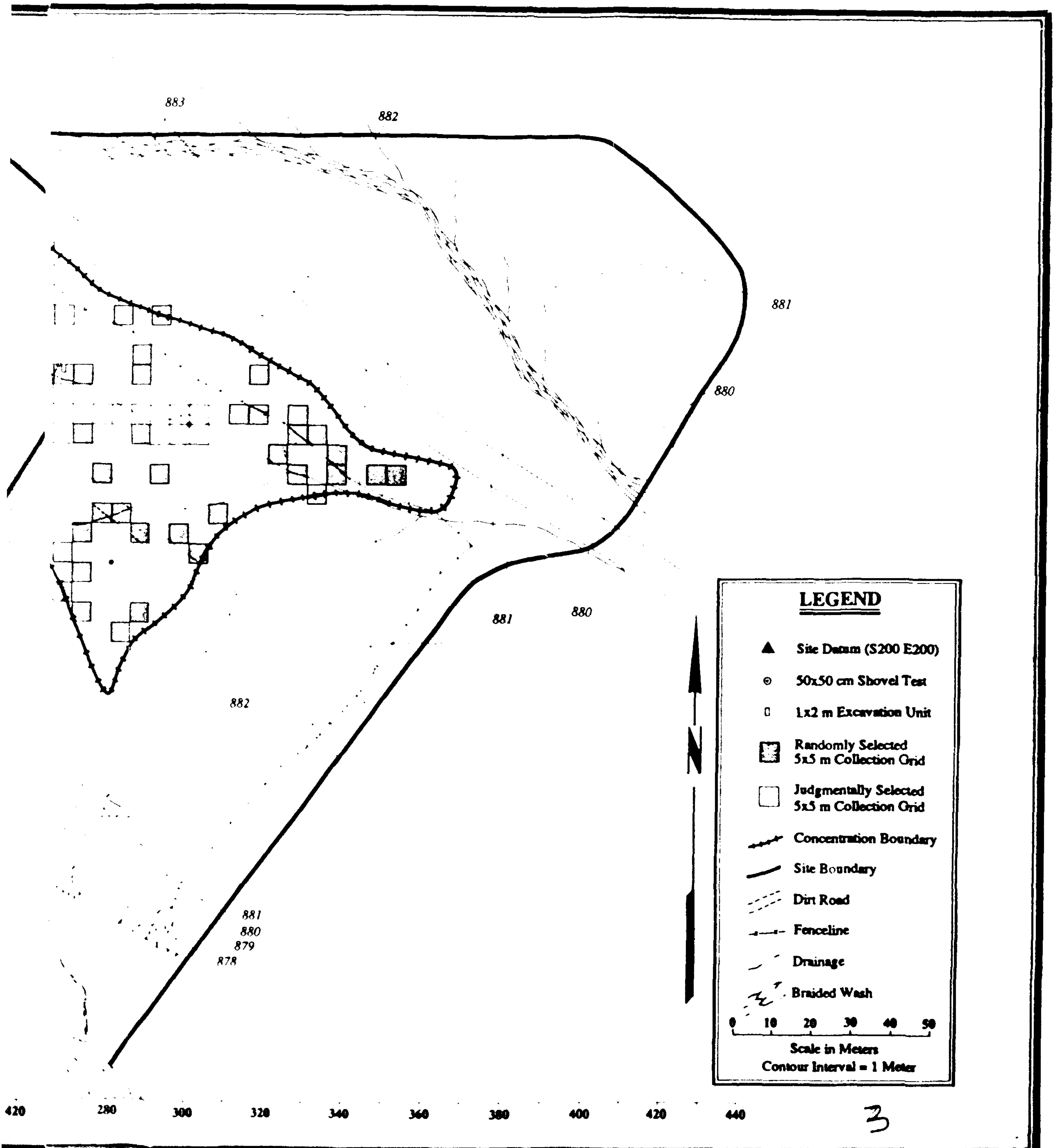


FIGURE 3-2. MAP OF SITE 4-SBR-4963

canyon. The drainage is intercepted by the meander that truncates the eastern end of the terrace. The Nelson Wash terrace has been heavily dissected by short steep drainage channels leaving six short wide ridges and numerous smaller ones. Several shallow rills (0.5 m deep and 1.0 m wide) drain sections of the site into the low area to the north side of the site. The northern half of the site slopes 1-2 degrees, while the Nelson Wash side slopes from 10 to 90 degrees. The cutbank of Nelson Wash reveals strata of well sorted small gravels and silty clays that were deposited in a fluvial environment, capped by weathered caliche soil.

The site was originally described as measuring 170 X 220 m and encompassing 9,200 m^2 (Robarchek et al. 1983:101) and consisted of an extensive flake scatter of chalcedonies and black basalts with a high proportion of tools and projectile points, but no clear evidence of a subsurface cultural deposit. Military activities have caused significant damage to the site. After Robarchek's archaeological survey in February, 1982, an artillery support group bivouacked on the northern border of the site. This area was devoid of vegetation and very little artifactual material was observed during the data recovery phase in July, 1983. A series of roads cross-cut the center and northern border of the site. These impacts have caused rills to form which erode the surface soils and displace the artifacts. This is particularly evident along the northeastern section of the site, where tools and debitage were concentrated in the rivulets.

Pinflagging of 4-SBr-4963 was the first step in data recovery at the site. It was accomplished by 13 persons, spaced approximately 2 m apart, who walked transects aligned along the short axis of the site (Figure 3-2). Pinflagging of the area revealed a light scattering of cultural material adjacent to the site as originally described (Robarcheck et al. 1983), adding approximately 10,350 m^2 to the original size of 9,200 m^2. However, this light scattering of cultural material consisted of flakes adjacent to the original site boundaries. It appears that the site boundary incorporating 9,200 m^2 is probably close to the boundary of the occupation area of the site. Post-deposition disturbance and runoff from rainstorms probably best explain the distribution of most of the flakes surrounding the site area.

A review of the location of tools is revealing and supports the interpretation of the area of occupation. No concentrations of cultural material were identified other than the original site area of 9,200 m^2. This area became the sampling universe on the assumption that it represented the approximate boundary of the original site area and that the outlying light scatter represented post-occupation displacement of the cultural remains. Several areas with greater tool concentrations than others were present within the original site boundary, and a sampling plan was implemented to ensure an adequate sample from these (Figure 3-2). Only 143 of the proposed 150 5X5 m units were utilized in the surface collection sample; 98 were randomly selected and 41 formed the judgmental sample. Four others were collected in error as part of the random sample. The number of tools and debitage recovered from the surface collections is given in Table 3-3.

Table 3-3: Results of Surface Collection at Site 4-SBr-4963.

Sample Types	5X5 m Units	Tools	Debitage
Random Sample	98	41	494
Judgmental Sample	41	30	504
Collected in Error	4	0	10
Total	143	71	1,012

In addition to the tools collected using the 5X5 m grid system, all other observed formal artifacts and obsidian found on the surface were collected and their locations documented by transit shots. Ninety-two tools and six obsidian flakes were recovered in this manner.

Shovel scrapes measuring 1X1 m were arbitrarily chosen from approximately one-half (45) of the randomly selected 5X5 m surface collection grids. Sixteen of these contained cultural

material, producing a total of 40 flakes and one tool. None of the judgmental units received surface scrapes.

To determine the presence and extent of a subsurface deposit at the site, 11 shovel tests, each measuring 50X50 cm were excavated. These were judgmentally positioned in such a way as to examine all areas of the site (Figure 3-2). Six shovel tests were excavated to 50 cm and five were excavated to 30 cm. One tool and 20 pieces of debitage were recovered from this effort. Although the shovel tests indicated that subsurface cultural material was sparse, five 1X2 m units were excavated in areas near those shovel tests which did exhibit subsurface deposition (Figure 3-2). The results of these excavation units paralleled those of the shovel tests, indicating again that the site has little subsurface deposition. Where found, the subsurface material was largely restricted to the first 15 cm below the surface. Table 3-4 outlines these results.

Table 3-4: Results of Excavation at Site 4-SBr-4963.

Excavation Unit	Depth (cm)	Bone	Tools	Debitage
S185E171	20-30	1	0	1
S225E250	Surface	0	0	1
	0-10	0	2	7
	10-20	0	0	14
S200E231	0-10	0	0	2
	10-20	0	0	9
	20-30	0	0	7
	30-40	0	0	1
S215E267	Surface	0	0	1
	0-10	0	1	10
	10-20	0	0	1
	20-30	0	0	5
S250E241	0-10	0	0	1
Total		1	3	60

Because the site showed no appreciable subsurface cultural deposition, further excavation was not undertaken.

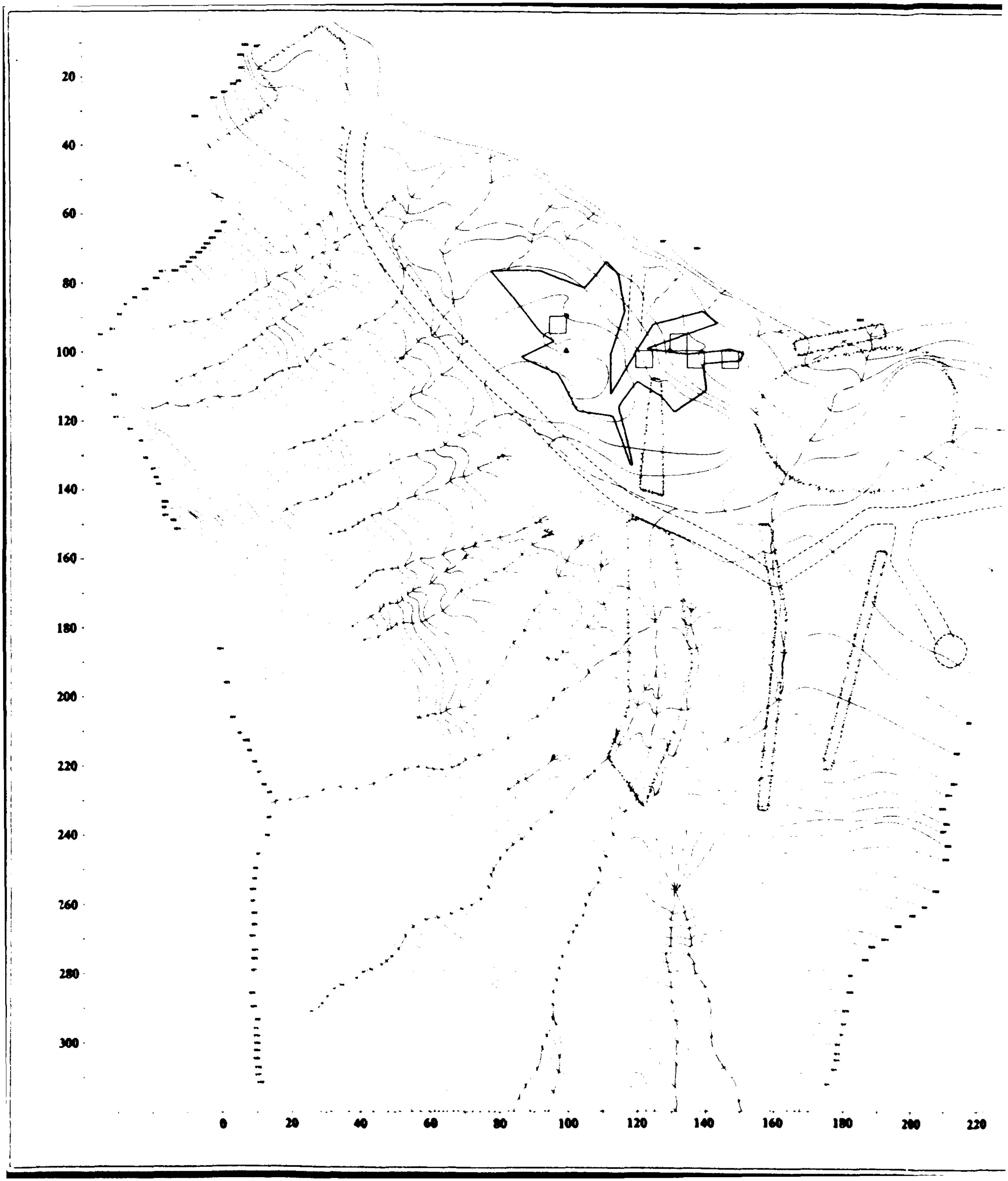
Site 4-SBr-4967

Site 4-SBr-4967 is situated at 881 m amsl on an outcrop of decomposing gneiss and schist, which forms a knoll on the southern side of Nelson Wash, about 700 m southeast of site 4-SBr-4963 (Figure 1-2). The outcrop, which juts out into the stream channel from the southern ridge bordering the canyon, may be a stream terrace or a resistant erosional remnant. It lies at an altitude comparable with other possible terraces along the canyon. The knoll is the upstream anchor of a lower steam terrace similar in composition and altitude to the terrace on which site 4-SBr-4963 is found. The surface both upstream and downstream from the knoll is relatively flat along an axis parallel to the stream and appears to be part of the terrace.

Rocks, including gneiss, schist and chlorite schist, outcrop in several places on the knoll and the Nelson Wash terrace, but most of the knoll surface is covered by a mantle of colluvial soil. The knoll rises 10 m above the modern Nelson Wash floodplain. It is partially separated from the adjoining hill by a drainage channel that flows between the two and then curves abruptly around the eastern side of the knoll, crosses the eastern edge of the site, and empties into Nelson Wash.

The site was originally recorded as measuring 100(NW-SE)X40-70(NE-SW) m and encompassing an area of approximately 4,700 m^2 (Robarchek et al. 1983:107). No artifact concentrations were observed, but approximately 80 flakes and 15 tools were recorded on the surface. Projectile points and unifacial tools of the Lake Mojave period were noted. Subsurface test excavations during the survey phase encountered no cultural material to a depth of 20 cm.

Impacts to this site have been greater than to any of the other project sites. Survey information indicated that destruction of the resource was probable due to both tracked vehicles and heavy equipment used for trenching and grading operations. Most of the impacts to the site and the surrounding area were incurred prior to the location and investigation of the site in early 1982.



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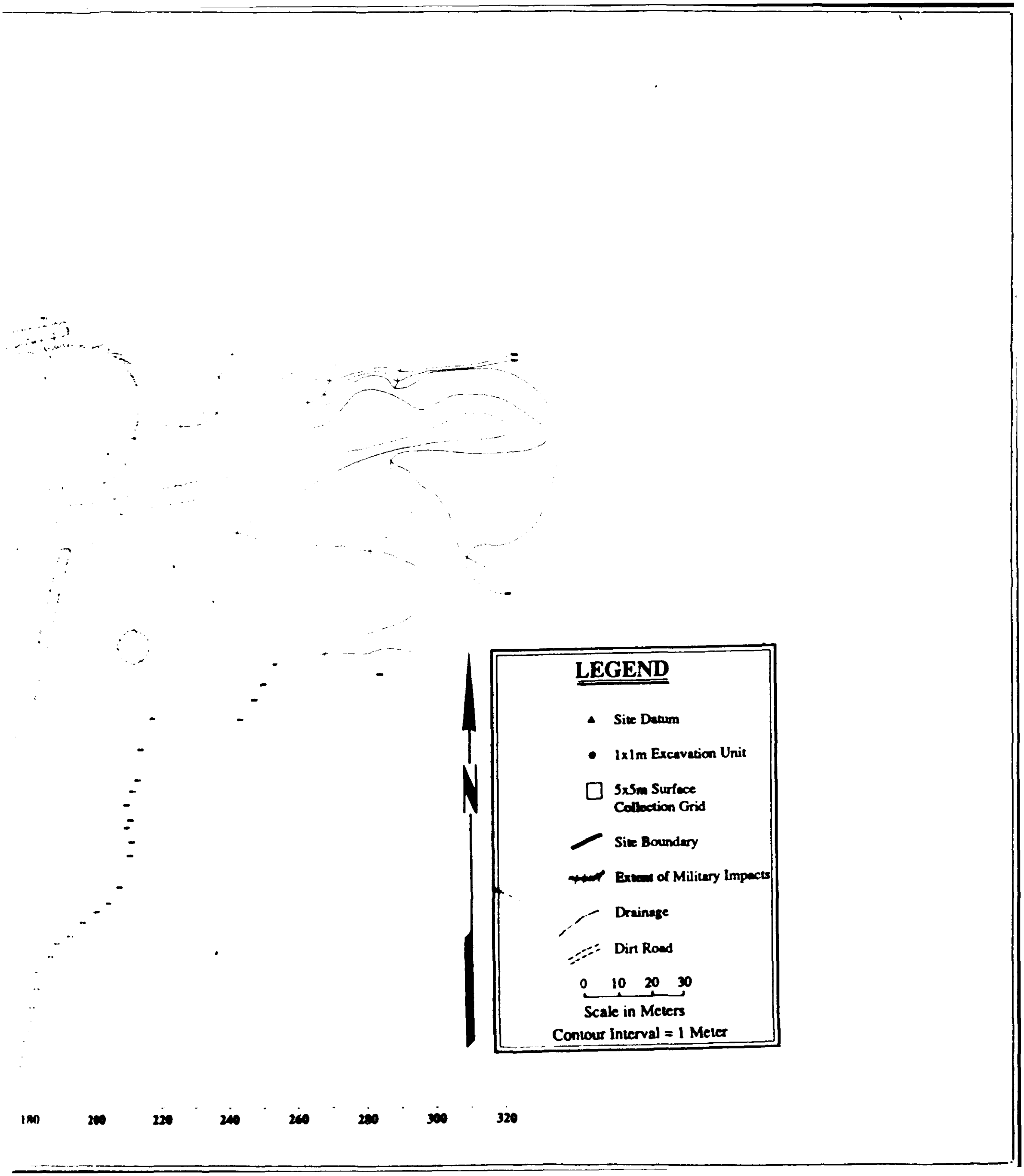
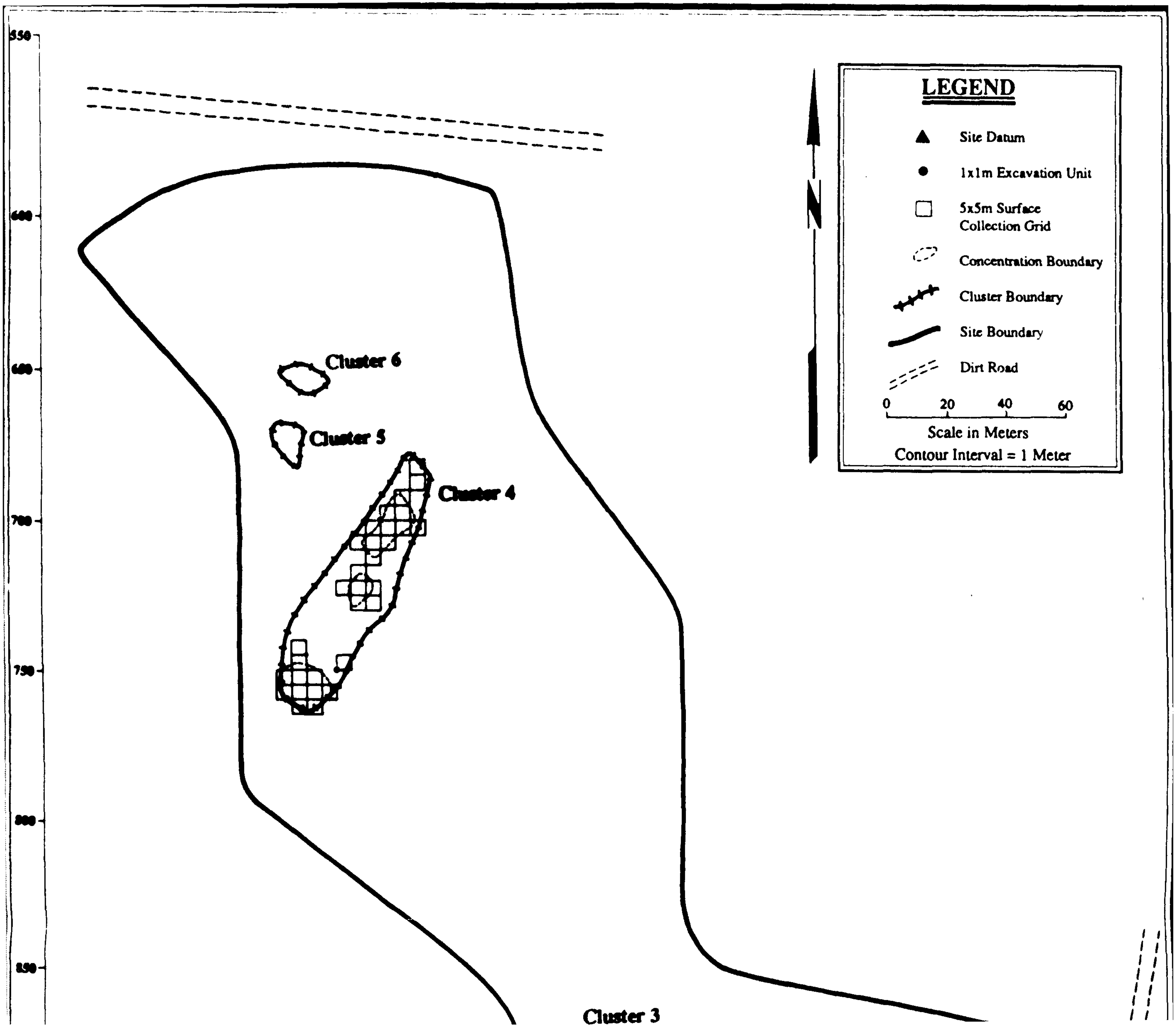

LEGEND
Site Datum
1x1m Excavation Unit
5x5m Surface Collection Grid
Site Boundary
Extent of Military Impacts
Drainage
Dirt Road
0 10 20 30
Scale in Meters
Contour Interval = 1 Meter
180
200
220
240
260
280
300
320

Since that time, the only known disturbance is a tank trail strip in the northern section of the site along the wash. Here, a tracked vehicle knocked over and buried a section of the fence erected by the Army as a measure to protect the site from such disturbance.

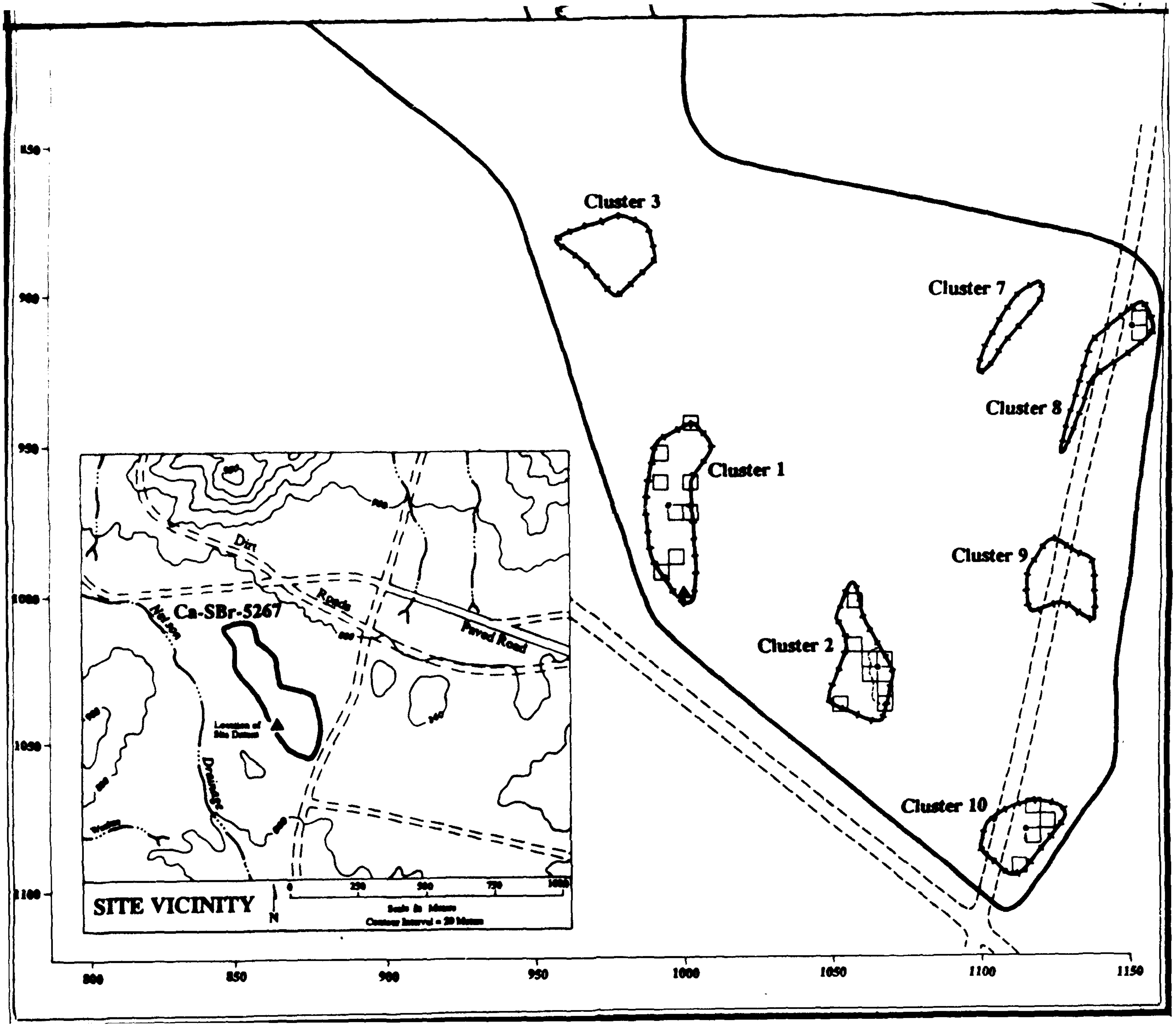
Survey and pinflagging of the site was accomplished using four crew members spaced 2 m apart. Transect lines were oriented northeast-southwest. This survey indicated that the site measured 120(NW-SE)X90(NE-SW) m, slightly larger than indicated by the original survey. The military impacts probably contributed to erosion of the steep areas of the knoll, causing some displacement of artifacts since the site was recorded in 1982. Pinflagging revealed no artifact concentrations, but the eastern side of the site did prove to contain more artifacts than the western section. For this reason four 5X5 m units were judgmentally placed in the eastern area, while one 5X5 m unit was place in the western area (Figure 3-3). Thirty-six flakes and five tools were recovered from the surface collection units, all of which were provenienced to the 5X5 m unit. No shovel scrapes were excavated within these units because of the gneiss and schist bedrock outcrops on the surface. Additionally, 79 flakes and 29 tools were collected and given provenience reference by transit (Figure 3-3). Two shovel tests, each measuring 50X50 cm, were excavated to a depth of 30 cm. Gneiss and schist cobbles and boulders were encountered, but no artifacts were recovered.

Site 4-SBr-5267

Site 4-SBr-5267, which lies at an elevation of 864 m amsl, is located 900 m east of site 4-SBr-4967, on the north side of Nelson Wash across from Hill 886 (Figure 1-2). It is situated on a 2 m high stream terrace formed when Nelson Wash flowed to the east of Hill 886. Today, most of the floodwaters that pass down the channel flow on the western side of the hill. The soil is an exhumed ochric argillic B horizon found at the toe of a 2 km long alluvial fan that is being deposited from the north. The surface is covered with angular feldspar and quartz gravel and cobble-sized clasts derived from the adjacent highlands and form a loosely formed pavement. The terrace has been divided into a series of interfluvial ridges by seven major southwesterly flowing ephemeral stream channels, the largest of which is nearly 600 m long and about 40 m



LEGEND
Site Datum
1x1m Excavation Unit
5x5m Surface Collection Grid
Concentration Boundary
Cluster Boundary
Site Boundary
Dirt Road
0
20
40
60
Scale in Meters
Contour Interval = 1 Meter
N
550
600
650
700
750
800
850
Cluster 6
Cluster 5
Cluster 4
Cluster 3


Cluster 3
Cluster 7
Cluster 8
Cluster 1
Cluster 9
Cluster 2
Cluster 10
850
900
950
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1050
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1050
1100
1150
Ca-SBr-5267
Dirt
Roads
Paved Road
Drainage
Location of Site Datum
SITE VICINITY
N
0
250
500
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Scale in Meters
Contour Interval = 20 Meters

wide at the mouth. These channels have deposited alluvium between the base of the terrace and the modern Nelson Wash and have exposed a caliche horizon beneath the B horizon on which the site lies. The cultural material found on the site is distributed on the eight or so interfluvial ridges formed by the stream channels, which have been further subdivided by numerous small drainages. The major ridges range from 225-450 m in length and 30-180 m in width.

Unlike other sites reported here, the work at 4-SBr-5267 did not constitute full data recovery, for the site was discovered in the course of the fieldwork reported herein. It consists of a light to moderate artifact scatter (5-50 items/25 m^2) which includes projectile points of the Pinto, Silver Lake and Lake Mojave types. Ground stone, large bifaces, unifaces and cores are also found in the site assemblage. In terms of cultural/chronological placement, it appears similar to the other data recovery sites discussed in this report. Prehistoric quarrying of pavement lithics, however, is not in evidence. Instead, the refinement of transported raw materials appears to have been the major lithic reduction activity.

The area of the site was projected as measuring 575(NW-SE)X180(NE-SW) m or 68,400 m^2. Only five days of mapping time were allotted for the site which included staking the surface collection units. Considering the circumstances under which the site was evaluated, the area size must be considered an estimate.

Because 4-SBr-5267 lies at the junction of two main roads, the southern and eastern edges of the site have been impacted by tracked vehicles. In addition, ordnance craters are present on several of the terraces, and these have caused or accelerated the breakdown of desert pavement surfaces. This area was cleared of all surface ordnance and military hardware prior to fieldwork. The fieldwork conducted at 4-SBr-5267 began with transit shot collections and gridding of areas for surface collection; contour mapping was not accomplished in this brief time span. Items recovered by transit include 392 flaked stone tools, 32 pieces of debitage and four ground stone objects. A minimum of pinflagging was conducted, tools only being marked. This resulted in the identification of 10 clusters or loci of tool concentrations. Further flagging of tools and debitage is necessary to accurately assess the site. Due to the limited time available

for the fieldwork, only five of the clusters were selected for surface collection with the 5X5 m grid. Clusters which had minimum surface disturbance and a high quantity of tools were chosen. These consisted of clusters 1, 2, 4, 8 and 10. Clusters 2 and 4 proved to contain smaller concentrations of tools, 100% of which were collected. The remainder of the two loci was sampled by a random selection of 5X5 m units. The surface collection effort is shown on Figure 3-4, and the type of sample and quantity of material recovered are listed below by locus in Table 3-5.

Table 3-5: Results of Surface Collection at Site 4-SBr-5267.

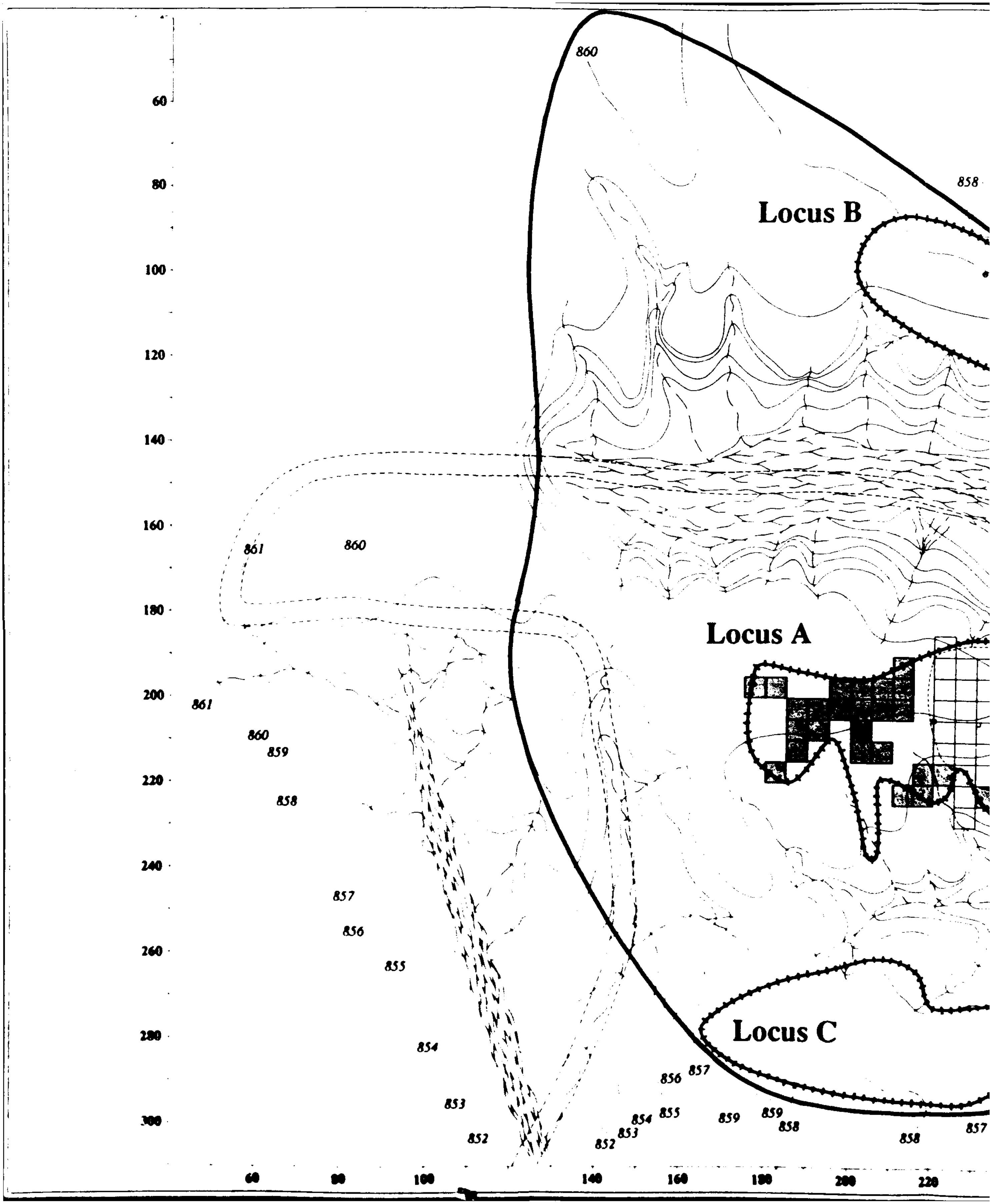
Cluster Locus	Area (m^2)	Sample Type	Percent of Area Collected	5X5 m Units	Tools	Debitage	Ground Stone
1 (A)	825	Random	25	8	7	41	0
2 (B)	375	Random	25	4	0	12	0
	150	Judgmental	100	6	10	76	1
4 (D)	1,275	Random	20	9	7	81	0
4 (D) - north	200	Judgmental	100	8	10	130	0
4 (D) - central	100	Judgmental	100	4	2	57	0
4 (D) - south	250	Judgmental	100	10	26	329	0
8 (H)	250	Judgmental	20	2	2	40	0
10 (J)	475	Random	20	4	14	16	0
Total				55	78	782	1

Surface scrapes and shovel tests excavations were also conducted at these five clusters. Four of 12 surface scrapes (those placed in Clusters 4, 8 and 10) produced a total of 10 flakes. Six 50X50 cm shovel tests were excavated to a 30 cm depth (Figure 3-4). Two units were excavated in Cluster 4 and one unit was excavated in each of the other clusters. Seventeen pieces of debitage were recovered in the shovel tests from Clusters 2, 4 and 8. These tests for subsurface deposits are minimal and included only a small segment of the site; decisions regarding the presence and nature of subsurface cultural deposits should not be made without more extensive subsurface testing.

Site 4-SBr-4968

Site 4-SBr-4968 is located near the mouth of Nelson Wash Canyon at the confluence of Nelson and Bicycle washes, 240 m west of site 4-SBr-4966 (Figure 1-2). It is situated at an elevation of 860 m amsl on a 13 m high stream terrace cut into fluvial gravels deposited sometime in the Quaternary period. The terrace has been dissected into three long narrow interfluvial ridges designated from north to south as Loci B, A and C (Figure 3-5). Locus A is found on a triangular ridge 300 m long by a maximum of 90 m wide. Locus B occurs on a sinuous semi-oval ridge 250 m long by a maximum of 90 m wide. Locus C is situated on an oval ridge 135 m long by 50 m wide. The terrace surface is a well developed heavily patinated gravel pavement that has many cobble sized and a few boulder sized clasts including unmodified metabasalt. Chalcedonies, chert, jasper and felsite are also present, for this is the toe of the extensive gravels that slope from the Ridge Site (4-SBr-4977) at 1-2 degrees down to Nelson Wash.

Site 4-SBr-4968 was originally described as measuring 240(E-W) X 264(N-S) m and occupying some 40,900 m^2 (Robarchek et al. 1983:108). Within the site the three fingers of pavement isolated by the cutting activity of washes form a smaller occupational surface, measuring 33,700 m^2 (Figure 3-5). During the survey, the northernmost pavement was designated as Locus B and the two southern pavements as Locus A. One of these was redesignated Locus C for the data recovery effort. All areas exhibited a thin, widespread scatter of lithic materials, while a dense



Locus B
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Locus C
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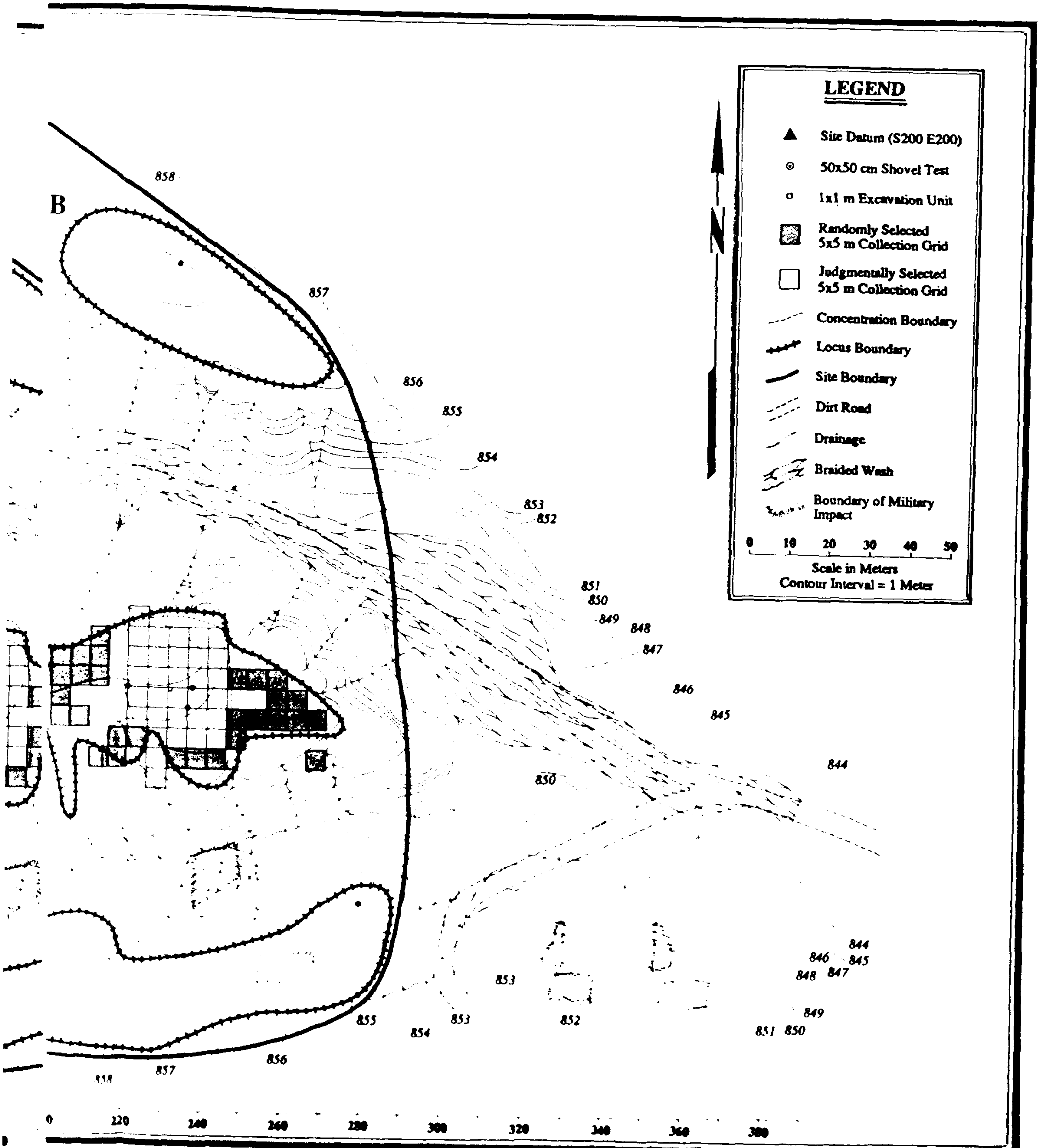


2 **FIGURE 3-5. MAP OF SITE 4-SBR-4968**

concentration of artifacts was noted in the eastern sections of the central pavement. Raw materials used by the occupants include felsite, basalt, chalcedony, chert and jasper. Most of these materials are present as part of the desert pavement surface and were probably procured for tool-making at the site (Robarchek et al. 1983:109).

Impacts to the site have been incurred by tracked vehicles maneuvering along the western border of the site. Locus A has suffered the greatest damage; deep tire tracks in the western section of the middle pavement have broken up the pavement surface and exposed the iron oxide-stained soil of the B horizon, and heavy equipment impacts resulting from the excavation of a rectangular shaped tank emplacement appear in the southeastern section.

To choose the sampling strata for the surface collection effort, the site was pinflagged to distinguish areas of concentration from areas of lower density. Pinflagging was accomplished by five surveyors spaced approximately 2 m apart. Transects were walked west-east across the pavement surfaces and all artifacts were flagged with color-coded pinflags, distinguishing the tools from the debitage. The central pavement of Locus A exhibited the densest artifact concentrations; therefore, the entire gridded surface collection effort was conducted at this part of the site (Figure 3-5). Because the eastern one-half of Locus A was not impacted, more artifacts were observed there than in the tank-tracked western section of the pavement. The sampling strata for surface collection were divided accordingly, and a larger number of units was assigned to the higher density area. As a result, 100% of this area was collected using 32 5X5 m units subdivided into 1X1 m squares for tighter provenience control (Figure 3-5). No discrete reduction stations were in evidence.

Thirty-eight 5X5 m units were selected from the remainder of the Locus A area, providing a 50% random sample (Figure 3-5). Materials collected in these units were provenienced to the 5X5 m grid rather than to the 1X1 m subdivisions within the grid. Table 3-6 presents the type and quantity of cultural material recovered in the 5X5 m surface collection effort at Locus A.

Table 3-6: Results of Surface Collection at Site 4-SBr-4968, Locus A.

Sample Type	Area* (m^2)	Percent of Area Collected	5x5 m Units	Tools	Debitage
Random	1,950	48.7	38	22	134
Judgmental	800	100.0**	32	80	458
Total	2,750		70	102	592

*approximate sizes.
**100% of high density area.

Locus B and Locus C contained a very light scatter of artifacts, all of which were collected individually with provenience recorded by transit (Figure 3-5). Sixty-eight tools, 151 flakes and one hammerstone were recovered from these two loci. Surface scrapes were excavated from a number of 5X5 m units within each of the sample strata from Locus A. Eighteen of these 1X1 m scrapes were placed in the randomly selected units and 31 were excavated in the block of 5X5 m units judgmentally placed in the high density area. Five shovel scrapes yielded three tools and two flakes from the random 5X5 m units and nine surface scrapes produced two tools and 12 pieces of debitage in the high density area.

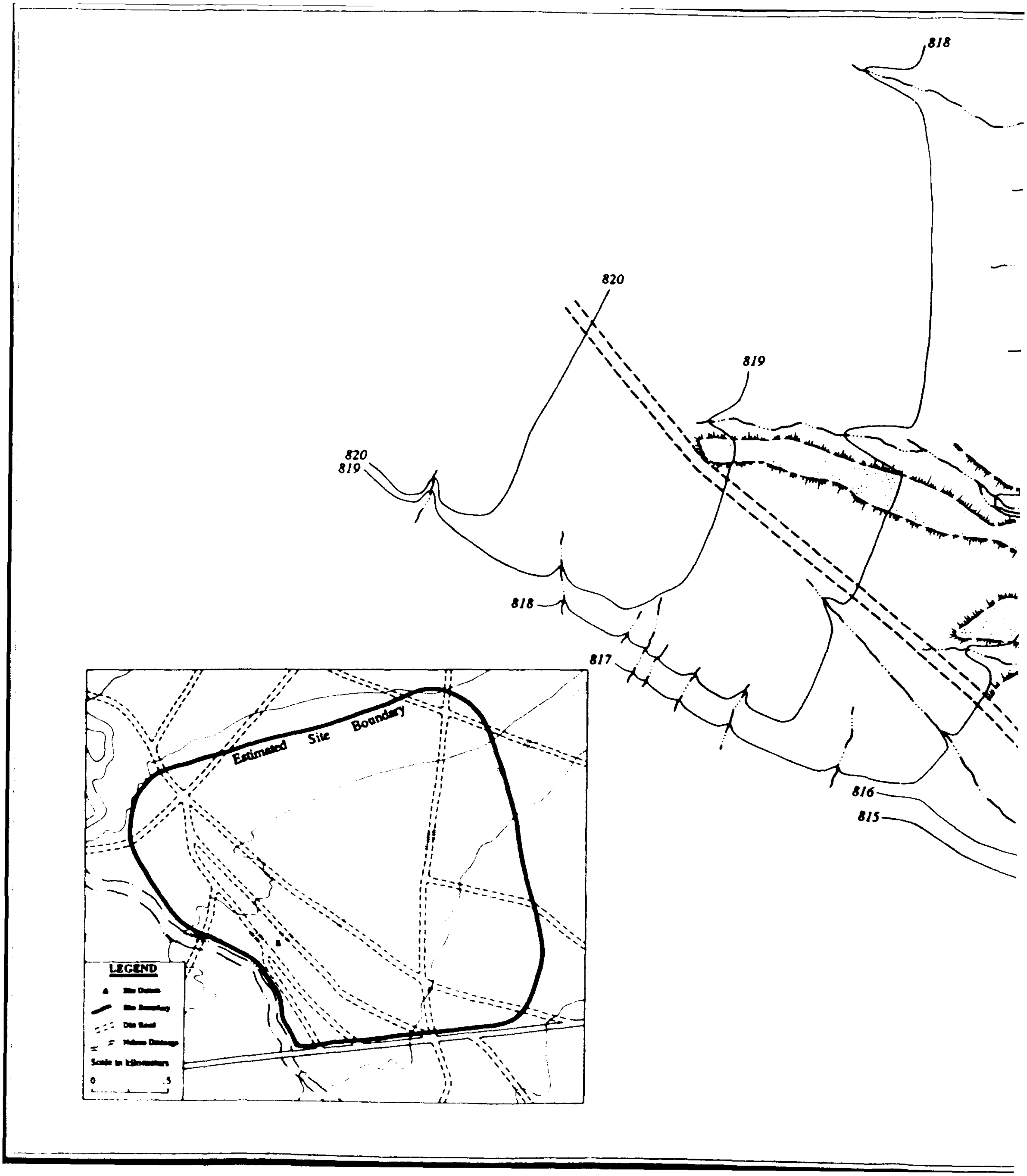
Testing for the presence of subsurface deposits was accomplished by excavating five 50X50 cm shovel tests. Three were excavated in the Locus A pavement and one each was placed in Locus B and Locus C (Figure 3-5). All were excavated to at least 30 cm, but results were minimal, two of those in Locus A producing a total of only five pieces of debitage. Because these tests did produce some material, it was decided that a 1X1 m excavation unit should be opened in this vicinity (Figure 3-5). One unit (S205 E230) was therefore excavated to a depth of 30 cm, recovering two flakes from the upper 20 cm. These tests indicate that 4-SBr-4968 contains no appreciable subsurface cultural deposits.

Site 4-SBr-4969

Site 4-SBr-4969 is located 1,100 m southeast of Nelson Wash along Bicycle Wash, east of Hill 910 (Figure 1-2), at an elevation of 780-840 m amsl. The southernmost of the sites, it differs from the others in that its primary concentrations are not on the margins of the main wash. Instead, they are in patches of well patinated cobbles and boulders of volcanics on the broad alluvial plain that is the toe of a large fan that has built out from the west along the axis of Bicycle Wash. This fan contains cobble and boulder sized clasts of black metabasalt and many archaeological sites are found on it, including the Ridge Site (4-SBr-4977). It is a wedge-shaped area with the apex at Hill 910. Its northern boundary lies along the line where the volcanic alluvium coalesces with the granitic alluvium building out from the Granite Mountains and its southwestern boundary lies along Bycycle Wash. The surface of the alluvial plain has numerous east-trending ephemeral stream channels that are usually less than 20 m wide and 1 m deep.

The surface of the western part of site 4-SBr-4969 is covered by a patinated gravel pavement made up of basalt, metabasalt, vesicular basalt, felsite and andesite. Patches of cobble and boulder sized clasts occur on the gravel pavements and most of the prehistoric quarry activity found on the site appears to be associated with these patches. To the east, well formed pavements do not exist, probably because that area is a more active toe of the fan. Cobbles do occur there but less frequently than in the pavement to the west. Both areas exhibit a thick ochric B horizon, but the pavement-free surfaces have 10-20 cm of sediment deposited on top of it, where a thin vesicular A horizon lies between the B horizon and the pavement surfaces. As recorded during the archaeological survey prior to the 1982 Gallant Eagle exercises (Robarchek et al. 1983:109), site 4-SBr-4969 measures 230(NW-SE) X 65(NE-SW) m and encompasses an area of approximately 12,400 m^2 (Figure 3-6).

Prehistoric activities at the site involved quarrying of the pavement nodules and initial reduction of the lithic materials. Nodules of metabasalt represent the most common lithic material found in the pavement, and it was this gray to black colored rock which was the preferred raw material for quarrying.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818
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816
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Estimated Site Boundary
LEGEND
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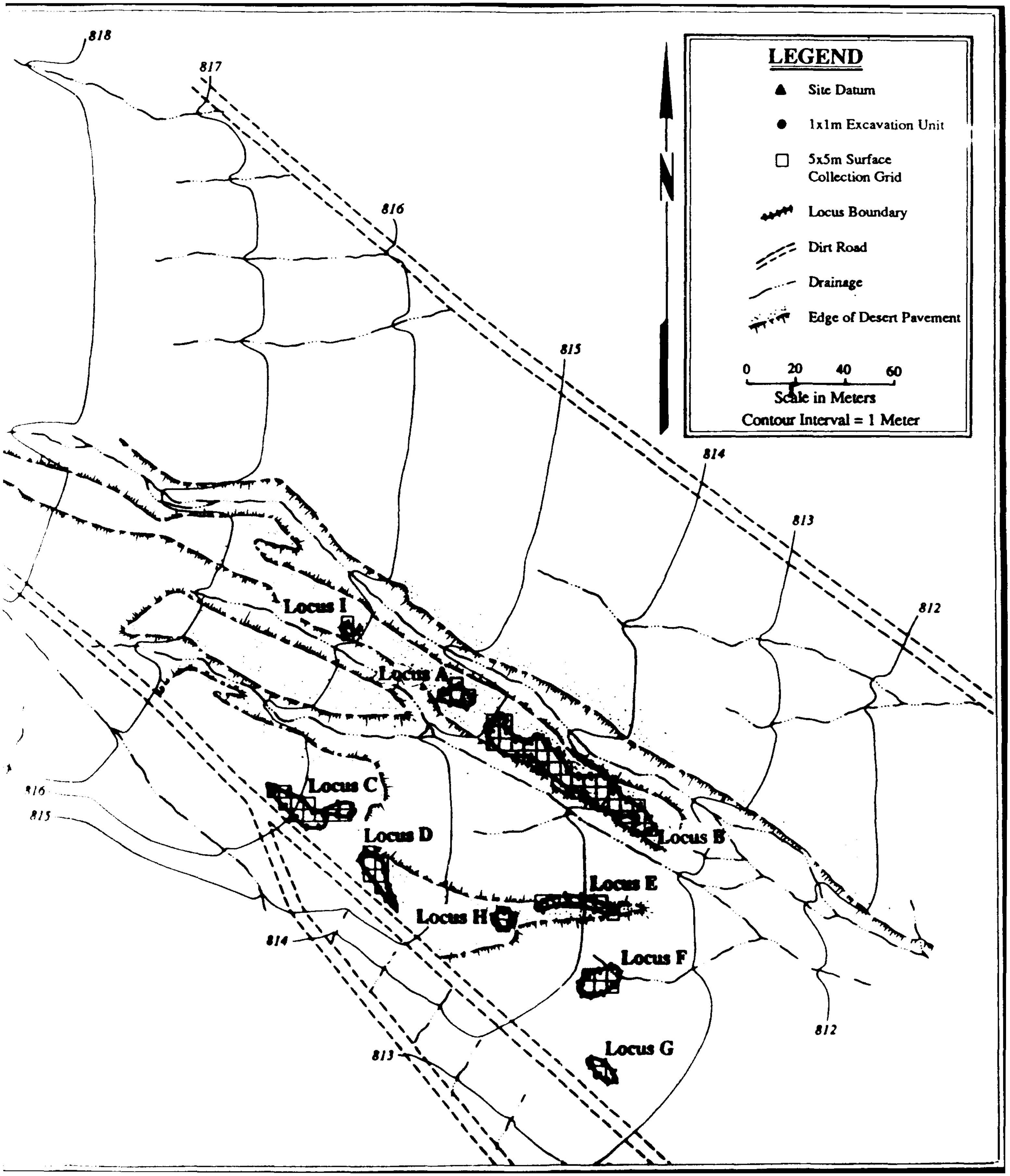


LEGEND
Site Datum
1x1m Excavation Unit
5x5m Surface Collection Grid
Locus Boundary
Dirt Road
Drainage
Edge of Desert Pavement
0 20 40 60
Scale in Meters
Contour Interval = 1 Meter
N
818
817
816
815
814
813
812
Locus I
Locus A
Locus B
Locus C
Locus D
Locus E
Locus F
Locus G
Locus H

Because of the presence of two military firing points, site 4-SBr-4969 suffers severe impacts from the bivouacking of military personnel in the areas adjacent to these firing locations. Elongate trenches, buried trash dumps and cleared campsite areas attest to the intensive military use of the site and its surroundings.

The site survey record states that the "lithic scatter continues with diminishing frequency on the pavement surfaces beyond the boundaries of the site" (Robarchek et al. 1983:110). A pedestrian inspection of the area adjacent to the site, as well as the collection effort of the mappers, indicates that the lithic scatters on the pavement surfaces outside the original site boundary appear to be as extensive as the widespread flake scatter on the pavement designated as site 4-SBr-4969. Additional survey of pavement surfaces as distant as 0.8 km to the northwest reveals that these areas were also used for obtaining and reducing raw material. A random check of other pavement surfaces some distance from the site identified other quarry areas to the west, south and east of the site. The extent of these surfaces has been estimated as 5 km^2. During fieldwork, this area, excluding the original area of 4-SBr-4969, was temporarily designated as RNSV-1. Subsequently, both have been combined and designated as 4-SBr-4969. The original site can now be considered as a locus, or series of loci, within the larger site.

During the course of fieldwork tools and manufacturing debris were observed on the pavement surfaces adjacent to the original site area. Survey and pinflagging were expanded to include these areas and a total of 90,700 m^2 is now considered as the study area (Figure 3-6). Sixteen artifact concentrations (loci) were recognized, but none represented discrete chipping stations. Two of these were present on the original site pavement and 14 were located on the adjacent pavement surfaces. All received a 100% surface collection using the 5X5 m grid for the collection of the larger concentrations and individual transit shot collections for the smaller loci. Sixty-nine 5X5 m units were collected and provenienced to the 5X5 m unit; Table 3-7 lists the quantity of tools and debitage recovered from these. Approximately one-half (36) of the 5X5 m units received 1X1 m shovel scrapes, producing an additional two tools and six flakes.

Table 3-7: Results of 5X5 m Surface Collection at Site 4-SBr-4969.

Locus	Area (m^2)	5X5 m Units	Tools	Debitage
A	76	4	6	128
B	553	31	28	479
C	202	10	4	167
D	125	6	3	48
E	96	7	3	97
F	131	6	4	141
G	43	1	0	14
H	18	2	3	39
I	37	2	0	33
Total	1,281	69	51	1,146

Other surface collections were made in localities outside the 4-SBr-4969 study area. These consisted of circle grid collections of discrete chipping loci (Figure 3-6, flake scatters 1-3). The rationale for including these flaking stations as part of the data recovery effort was three-fold: (1) these areas adjacent to 4-SBr-4969 were not recorded as archaeological sites during the Gallant Eagle survey; (2) Range 14 encompasses the area contiguous to the site and the target date for construction and development of the range facility was April, 1984, precluding additional data recovery in these areas; and (3) the presence of several intact chipping loci outside the main site area may provide data on the stage of lithic production to which quarried materials were processed. This information will aid in the interpretation of the lithic activities in the 4-SBr-4969 study area, where discrete flaking concentrations are not found or are no longer intact. Technically, these flake scatters lie outside the newly defined site boundaries, but they are provenienced as part of the site.

Three discrete flake concentrations were chosen for collection using the 2 m diameter circle grid (Figure 3-6, flake scatters 1-3). Others were present in the area, but these three exhibited fewer military impacts and showed a tight clustering of the by-products of cobble reduction. The circle

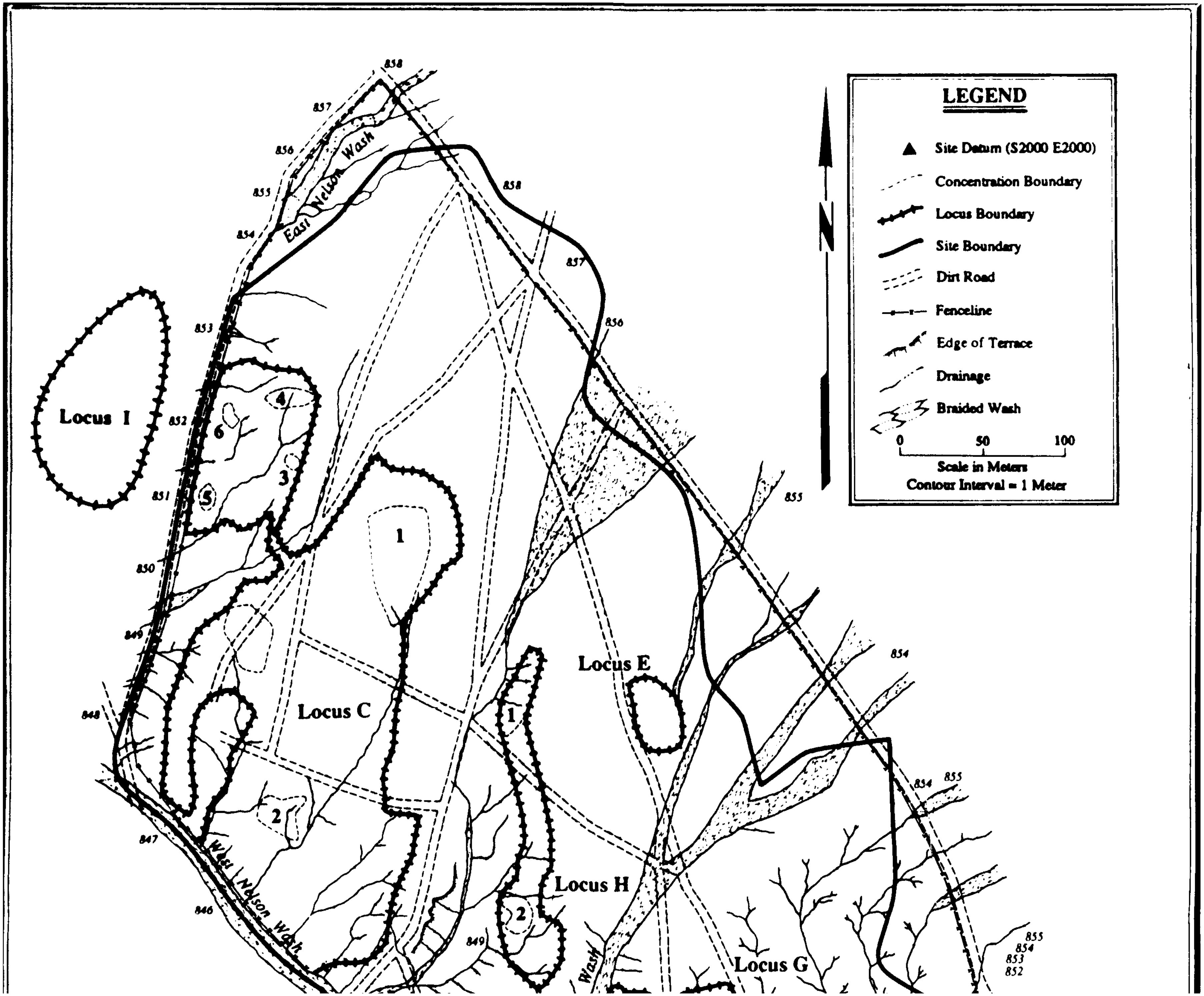
grid is subdivided into four concentric circles with diameters of 0.5 m, 1.0 m, 1.5 m, 2.0 m. For surface collection, the grid template is centered over the area showing the densest concentration of cultural material and the subdivisions of the circle are used as the provenience unit. Tools or cores recognized in the circle grid unit are given an item provenience by triangulation from two fixed points on the grid template. Debitage associated with the flake scatter, but found outside the 2 m boundary circle, is collected and provenienced as "outside grid." To be consistent with the methods used in the 5X5 m collections, a single 1X1 m unit was surface scraped to a depth of 3 cm, the northwest quadrant of the circle being designated for this purpose. Material recovered from the flake concentrations is listed below in Table 3-8. The three surface scrapes provided only three flakes.

Point provenienced items include tools, flakes, and small, discrete flake scatters. Sixty-two tools and 928 flakes were collected by transit shot from the study area (Figure 3-6). These, in addition to the 5X5 m surface collection units, represented a 100% surface recovery of the present study area of 4-SBr-4969.

Testing for the presence of subsurface cultural deposits was accomplished by excavating six 50X50 cm shovel tests (Figure 3-6), one each at Loci A, C, H and I and two at the larger Locus B. All units were excavated to a depth of 30 cm, but cultural material was limited to the 0-10 cm level. One tool and six flakes were recovered from the six units.Table 3-8: Results of Circle Grid Collection at Site 4-SBr-4969.

Implications of Small Sites Surface Sample

The small sites can be thought of in three categories based on their natural environment and resources. The four northern ones, 4-SBr-4965, -4963, -4967, and -5267, are on the margins of the wash on surfaces that predate the occupation and lack raw materials for lithic manufacture. The two southern ones, 4-SBr-4968 and -4969, are on pavements that include workable cobble-sized clasts of metabasalts and cryptocrystalline silicates, but the main


LEGEND
Site Datum (S2000 E2000)
Concentration Boundary
Locus Boundary
Site Boundary
Dirt Road
Fenceline
Edge of Terrace
Drainage
Braided Wash
0
50
100
Scale in Meters
Contour Interval = 1 Meter
N
Locus I
Locus C
Locus E
Locus H
Locus G
East Nelson Wash
West Nelson Wash
Wash
1
2
3
4
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6
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857
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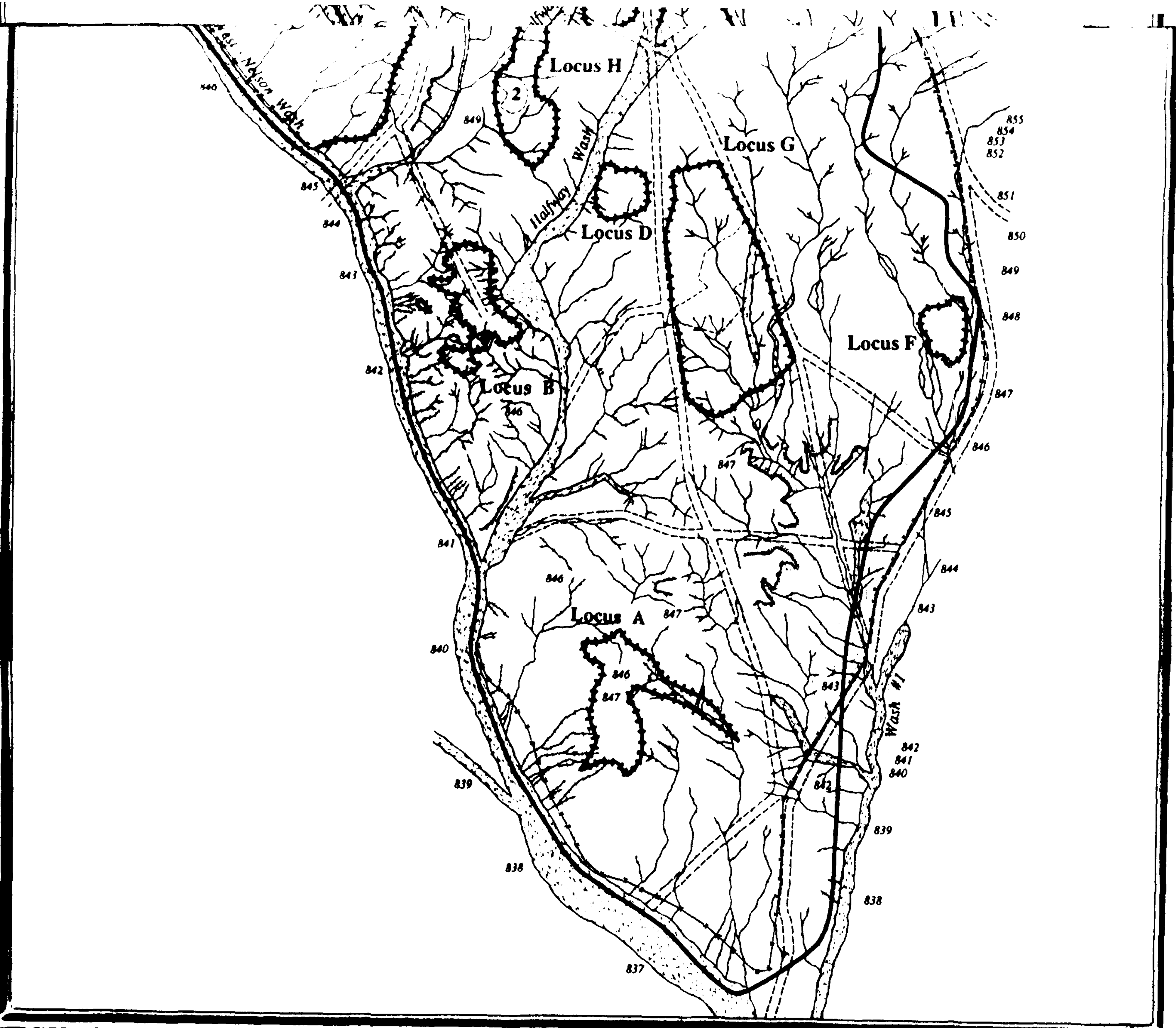


FIGURE 3-7. MAP OF SITE 4-SBR-4966

Table 3-8: Results of Circle Grid Collection at Site 4-SBr-4969.

Circle Grid No.	Collection Unit*	Tools	Debitage
1	A	0	8
	B	2	38
	C	0	22
	D	0	23
	Outside Grid	0	31
2	A	0	1
	B	0	2
	C	2	10
	D	4	8
	Outside Grid	0	1
3	A	1	2
	B	0	5
	C	0	1
	D	0	1
	Outside Grid	0	0
Total			11161

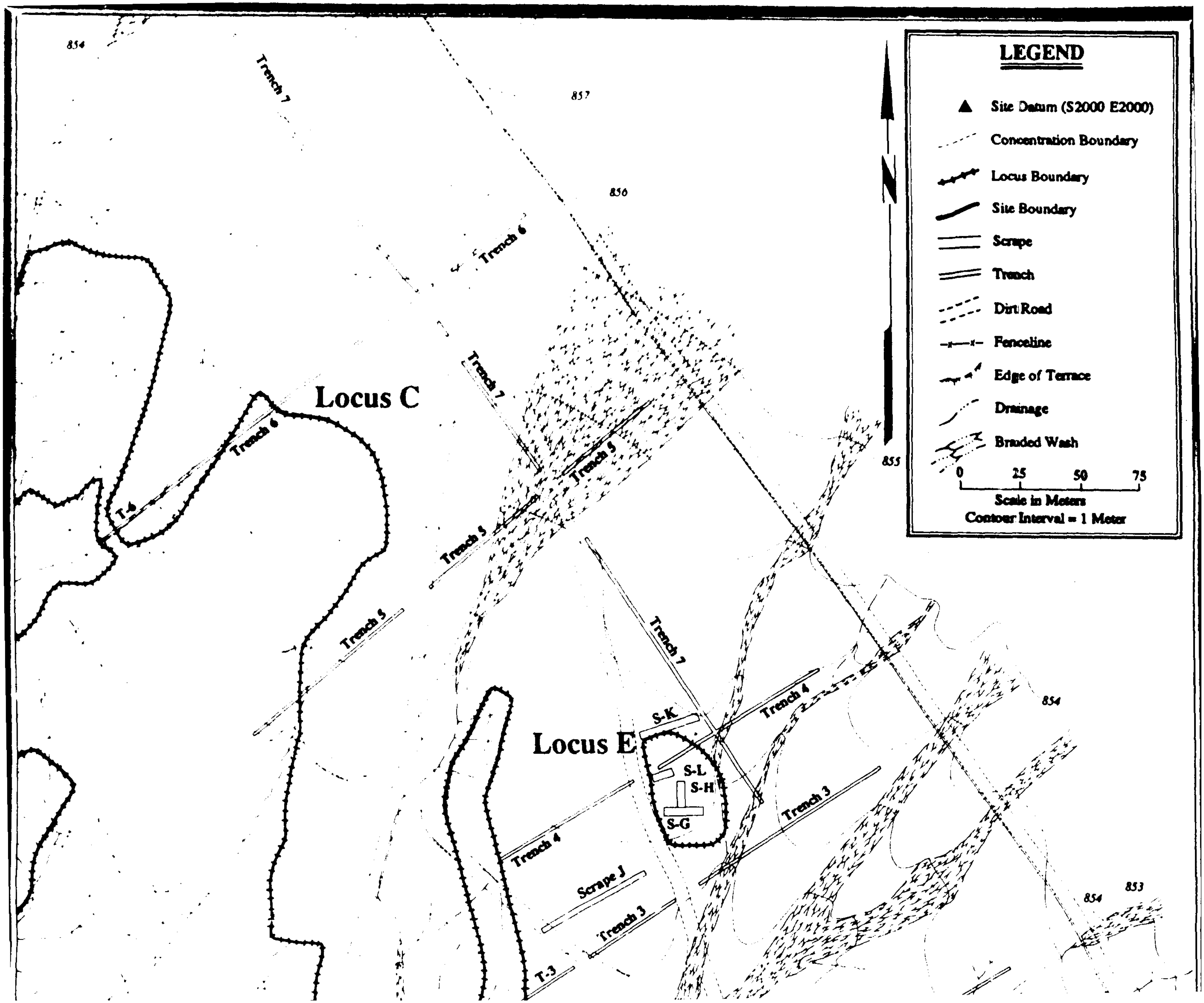
*A:Center-0.5 m; B: 0.5-1.0 m; C: 1.0-1.5 m; D: 1.5-2.0 m.

however, are not directly comparable. That aspect of sampling was compromised by the limited effort available, the need to maximize the number of items recovered by concentrating sampling in the densest parts of sites, and the need to collect blocks of contiguous squares in what might prove to be activity areas. Despite the effort to maximize the number of tools that were collected, recovery of many important classes of materials was low, and samples from the small sites are minimal for between-site comparisons. In the course of the analysis, we will identify the tool categories that seem to be consistently recognized and collected in the course of pinflagging and other walkover methods, and are thus adequately represented in the transit provenienced materials. The frequencies of these tool classes will form the basis of one comparison between sites. Frequencies of other classes such as flakes and informal tools are probably best estimated from the controlled collections of the 5X5 m units, and here the random samples will be used. It must be remembered that in the case of each site, these are samples of only selected portions of that site.

THE HENWOOD SITE (4-SBr-4966) DATA RECOVERY

The Henwood site (Figure 3-7), the largest and most complex site so far recorded on Nelson Wash, is located on the east side of Nelson Wash just above the confluence of Nelson Wash and Bicycle Wash (Figure 1-2). It is an oval area measuring 440X1120 m, with its long axis oriented in a northerly direction along the margin of Nelson Wash. The site is between 840 and 860 m amsl elevation and is at the mouth of Nelson Canyon. The site is bounded on the east by metamorphosed granite hills that are divided by a short canyon that terminates in a saddle. The majority of the cultural material is found between these hills and a stream terrace that forms the eastern boundary of the modern Nelson Drainage floodplain. Nelson Drainage is bounded on the west by a 6 m high terrace composed of well-rounded fluvial gravels. No terrace of equal composition or elevation was found on the eastern side of the canyon; rather, the terrace on the eastern side is lower and composed of finer-grained sediments.

The site was identified during the 1982 survey for the Gallant Eagle exercises (Robarchek et al. 1983:105-107,168-177). Later, in 1983, a testing and evaluation phase was carried out and the


LEGEND
Site Datum (S2000 E2000)
Concentration Boundary
Locus Boundary
Site Boundary
Scrape
Trench
Dirt Road
Fenceline
Edge of Terrace
Drainage
Braided Wash
0
25
50
75
Scale in Meters
Contour Interval = 1 Meter
N
Locus C
Locus E
Trench 7
Trench 6
Trench 5
Trench 4
Trench 3
Scrape J
T-6
T-3
S-K
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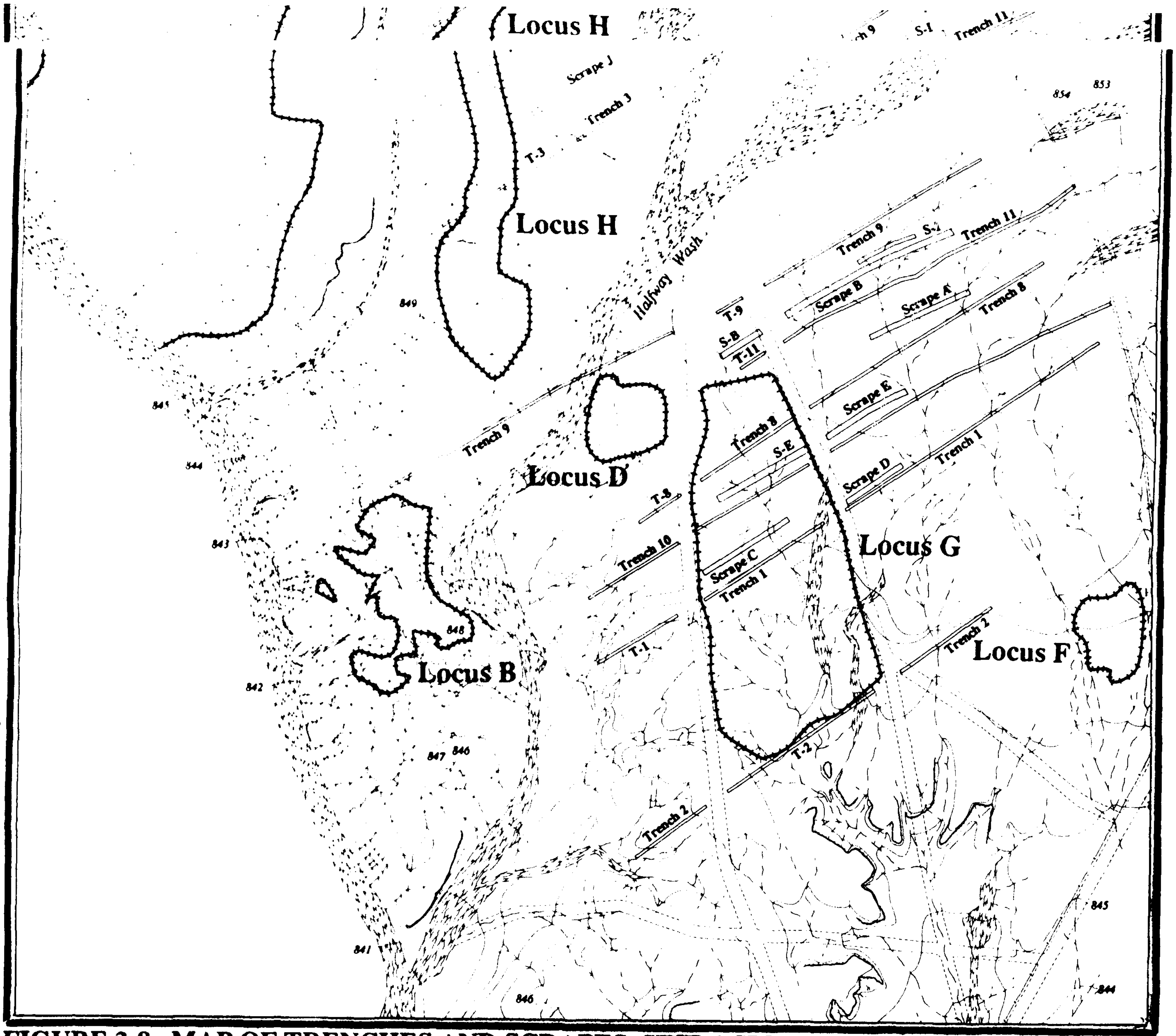


FIGURE 3-8. MAP OF TRENCHES AND SCRAPES, SITE 4-SBR-4966

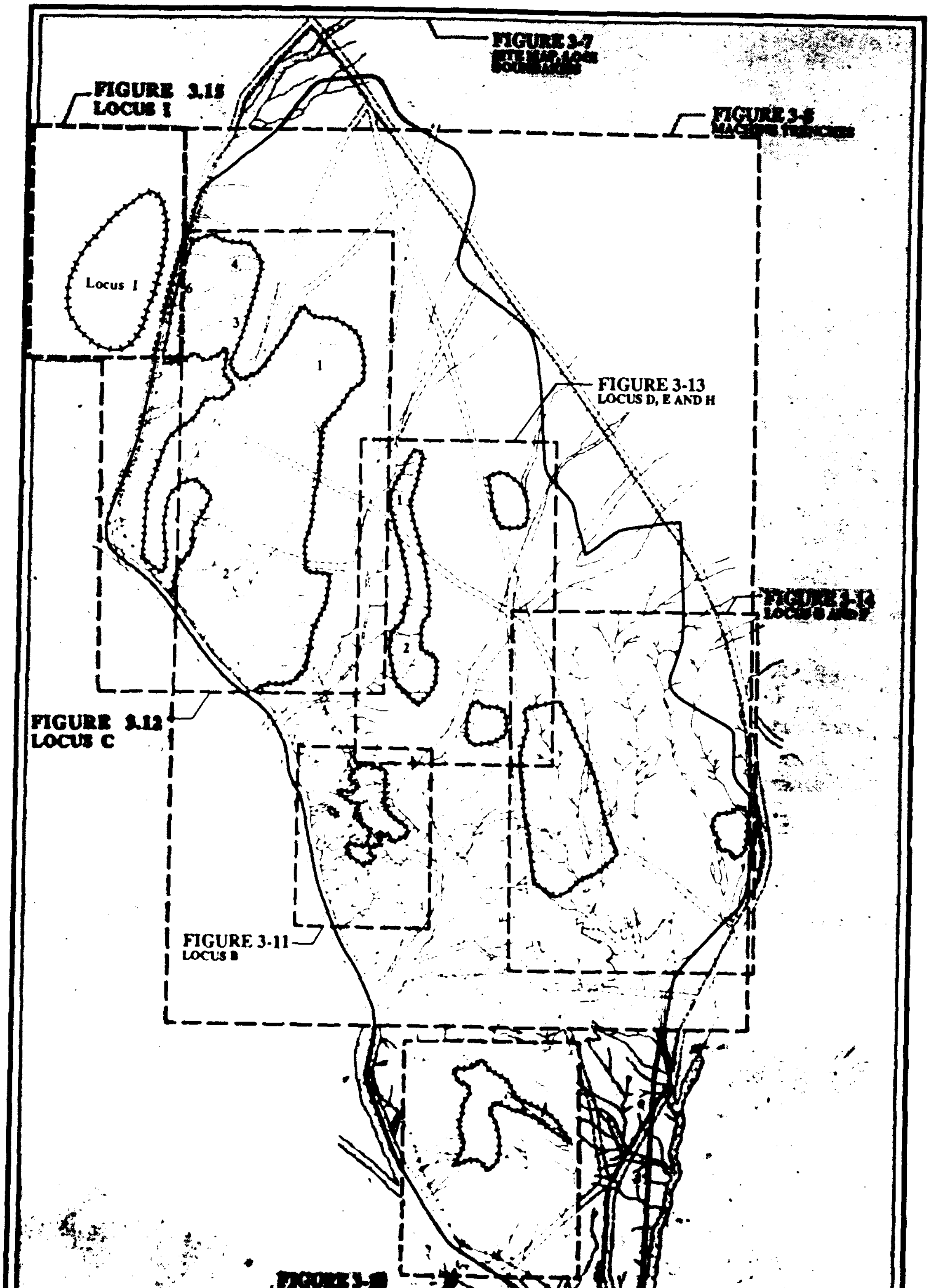


FIGURE 3-9. KEY MAP, SITE 4-SBR-4966

site area was increased to include an area to the northwest of the original site boundary (Skinner 1984:203-224). At present, this extension of the site is referred to as Locus I and encompasses 9,000 m^2. The total area of the Henwood site (4-SBr-4966) is 0.404 km^2.

The site is associated with stream terrace deposits capped by caliche. Dissected alluvial fans prograde toward the northern sections of the site from the surrounding bedrock highlands (Bachhuber 1984). These fans have deposited a layer of alluvium over the stream terrace deposits along the northern and eastern sections of the Henwood site. As a result, the western and southern one-third of the site appears very different from the northern and eastern alluvial-covered areas (see Chapter 2).

During the survey and evaluation phase, nine 1X1 m units were excavated, exposing cultural remains in association with fan deposits. Units excavated in the alluvial fan deposits showed cultural material extending to a depth of 70 cm. In contrast, those units placed on the pediment surfaces along the western margins of the site recovered cultural material to a depth of only 10-15 cm.

Military impacts to the site have been extensive. Several tank targets were placed in the northwestern portion of the site and ordnance, shrapnel and other military hardware covered that area during the testing phase (Skinner 1984: Appendix H, Map 6). This impact area was not assessed during the testing phase because of the potential danger to the field personnel. Prior to the beginning of the data recovery phase, ordnance, scrap metal, and tank hulks were cleared by Army personnel from all sites scheduled for data recovery.

Locus Determination

Seven loci or areas of surface artifact concentration were identified in the testing phase at the Henwood site (Skinner 1984:203-224). The boundaries of five of these loci were not changed for the data recovery effort, but those of Locus III and Locus VII were. Locus III was the target and impact area which was not thoroughly investigated during the survey and testing phase

due to the potential danger to field personnel. Following the Army's removal of the ordnance and tank targets a closer inspection of the area revealed a widespread scatter of artifacts. This area was then pinflagged in order to identify concentration of tools and debitage, facilitating decisions on selecting a surface collection sample from the area. Skinner's (1984: Appendix H, Map 6), Loci III and VII together with some additional area was designated as Locus C for the data recovery effort (Figure 3-7).

Three new artifact concentrations, designated as Loci G, H, and I, were identified and pinflagged during data recovery. Backhoe Trench 1 (Figure 3-8), excavated at the beginning of the field work, turned up a metate and several flakes at a depth of approximately 30 cm. Inspection of the surface surrounding the trench showed a number of tools and projectile points in the area. The area was pinflagged and designated as Locus G (Figure 3-7).

Northwest of Locus G, a moderate scatter of debitage was noted which appeared to have more chert and chalcedony tools and debitage than other loci at the site. It was decided that this area, designated Locus H, should be pinflagged to determine the boundaries of the concentration (Figure 3-7).

The area to the northwest of the site boundary, as originally surveyed, was included as part of the site in the testing and evaluation phase (Skinner 1984:203-224) but was not surveyed or collected at that time because of the heavy military impacts. After the Army cleared the area of ordnance, an archaeological crew pinflagged the area designated as Locus I.

Nine major concentrations of surface materials were defined as loci on the site. Each of these was treated as a universe for sampling with 5X5 m units. The site as a whole was not pinflagged in this phase of work, but selected loci were. Several of the loci were found to be complex and sampling took account of concentrations within them.

In general, surface loci of 4-SBr-4966 are comparable to the small sites. They tend to be smaller than the small sites in area, but their ranges largely overlap. Densities of materials are

generally higher on loci of 4-SBr-4966, and the samples from these loci tend to be larger than those from the small sites, although the ranges of sample sizes and material densities also largely overlap. Samples were allocated disproportionately and judgmentally within loci at 4-SBr-4966, just as they were among loci at small sites. Thus the samples from 4-SBr-4966 have the same problems of comparability among them as do the small-site samples.

Loci A and B are situated on outcrops. Loci D, H, I and most of Locus C are situated on exposures of sedimentary Unit C. These loci resemble the small sites in exhibiting no subsurface material except that which is probably stirred into the upper level by mixing. Under present conditions, these portions of the site have not been buried by recent alluviation from the RNGD fan, for the toe of it does not extend to the margins of Nelson Wash. We cannot tell whether the fan has reached Nelson Wash in the vicinity of these loci during Holocene times, making more complicated the possible interpretations of the processes that result in the present distribution of artifacts on these loci. If these surfaces were denuded at the time of occupation, and have remained exposed since, then the primary natural processes that may have acted on the assemblages would be some removal of the smaller flakes though localized erosion into the feeder channels of Nelson Wash. If, however, the recent alluvium once stretched across these loci, it may have included small amounts of small pieces of artifactual material transported with it and now incorporated in the artifact concentrations that remain. Since these surfaces do not exhibit clasts of the granitic and metamorphic rock from the source of the fan, it seems reasonable to assume that if the fan did once cover the now-denuded areas, it did not have the power to transport artifact-size pieces to these localities. As a result, we treat these materials as though they are more or less where they were left by prehistoric people.

The boundaries of these loci are in some part the product of natural processes. Locus A is essentially congruent with the outlines of the knoll of chlorite schist. Locus B is also a granitic outcrop bounded on about two-thirds of its perimeter by washes. Concentrations 3, 4, 5 and 6 of Locus C are situated in patches of fluvial gravel. Loci D and H are on old soil exposed by erosion on the margins of the larger washes that cut the site and drain into Nelson Wash. And finally, Locus I is on an interfluvial ridge in Nelson Wash. In each of these cases, aboriginal

occupation may have been constrained by and adjusted to these features of the terrain, but to some extent the size and shape of loci may have been modified by removal of materials from their margins.

More important to the analysis and understanding of the loci is to recognize that the cultural deposits on these denuded surfaces must be considered as the composite result of many uses of the locality. No illusion that we are able to resolve single discrete activity areas can be sustained. We can know neither how many reuses are represented nor the number of years over which particular localities were occasionally occupied. Perhaps over the years, however, there were tendencies to carry on some kinds of activities near the margins of the wash and others in the site's interior, and it is with this in mind that we examine the surface collections from 4-SBr-4966.

Surface collections from Loci E, F, and G are more difficult to interpret. They are on alluvial sediments, and transport of at least smaller objects cannot be ruled out. In these areas, tools and flakes appear to be in some sense concentrated on the surface, suggesting either that that surface stabilized prior to the final uses of the site, or that there has been some removal of surficial sediment particles by either aeolian or water transport, leaving behind artifacts from the upper few centimeters of the deposit as a lag. This lag would also include artifacts brought to the surface by rodent disturbance. We do not consider large-scale transport of archaeological materials down the fan during high-runoff events to have been an important process at 4-SBr-4966, for neither the surficial or subsurface distributions show the sorting and alignment of flakes that we have observed on other sites such as the Crossroads site, where this process is evident (Skinner 1984). The materials on the surface of Loci E and G should be younger stratigraphically than the buried material in the underlying alluvial sediments, according to this argument. More pertinent to the consideration of the surface materials, they are then to be considered to be more or less in place. Like the artifact distribution on old surfaces, they are probably to some extent composites of more than one use of the site, but they are not lags in which all the cultural materials of that portion of the site are now fully collapsed and combined.

Surface Collection

Two types of surface collections were used to recover artifacts from the Henwood site. A gridded 5X5 m frame was used to collect artifacts from loci and individual transit shots were used to collect and provenience all tools not recovered by the surface grids. The quantity of material collected as transit shot pick-ups is as follows: lithic tools, 1,510; debitage, 846; and ground stone, 19. Only tools, including ground stone, were originally to be collected with transit. Loci B, G, and H, however, showed higher quantities of cryptocrystalline quartz debitage than other loci. These loci were singled out and all chert and chalcedony debitage was collected with the idea that activity sets might be identified which relate to the production or use of chert/chalcedony tools.

Each locus was treated as a universe for sampling with 5X5 m surface collection units. Sampling plans are indicated on Figures 13-18; Figure 3-9 presents a key to the individual locus maps. The sampling rationale, the number of sample units chosen, the collection procedure, the number of units receiving surface scrapes and the quantity of material recovered will be discussed separately for each locus.

Heavy Equipment Excavation by David D. Ferraro

A series of trenches was excavated at site 4-SBr-4966 using a tractor mounted box blade and backhoe. The backhoe trenches were 24 and 36 inches wide and varied in depth from 0.2 to 3.0 m and in length from 142 to 318 m (Figure 3-8, Trenches 1-10; Figure 3-15, Trench 11). In all, 2,463 m of trenches were excavated.

The proposal for data recovery stated that backhoe trenches were to be excavated at 20 m intervals across the site. For two reasons this 20 m spacing between trenches was not implemented: (1) the safety of the field crew working near heavy equipment would be in jeopardy by the possibility of detonating subsurface ordnance; and (2) the initial trench areas were selected for stratigraphic comparisons across the site, from east to west. Cuts at 20 m increments would not be necessary to provide a good cross section view of the site stratigraphy from north to south. For the initial excavation, trenches were dug at approximately 100 m intervals (Figure 3-8, Trenches 1-6).

The backhoe trenches were excavated for two reasons. First, the Henwood site covers 404,000 m^2 and the proposed excavation sample was only 400 m^2. In addition, the cultural material was relatively diffuse. Therefore, the backhoe was used to explore the site's sub-surface in hope of finding buried cultural features and artifact concentrations. The trenches were concentrated in those areas where test excavations had indicated the presence of subsurface cultural material. After excavation, the trench walls were examined for the presence of charcoal and artifacts. The spoil pile was also examined for artifacts and these were marked with pinflags. Two significant artifact concentrations and five possible hearths were located in this manner.

The second reason for the backhoe exploration was to establish the geologic context in which the site was found. The site was known to be geologically complex (Bachhuber 1983) and to exhibit extensive areas of two soils that differ in both age and origin. The soils nearer the hills on the eastern side of the site were deposited by a complex alluvial fan environment. The soils on the western side of the site adjacent to Nelson Wash were laid down in a fluvial environment.

The majority of the buried cultural material was associated with the alluvial fan soils whereas most of the cultural material found on the fluvial soils was limited to the surface. The trenches helped to provide some understanding of the internal complexity of the alluvial soils and their interrelationship with the fluvial soils. In particular, they were useful in establishing a relative chronology of the various events that make up the geologic history of the site. For this reason, some of the trenches were extended into the fluvial sediments.

During the final two months of fieldwork, after excavation of the backhoe trenches, the need arose to further explore the subsurface of the culturally productive areas. Cultural material had been found concentrated in small "pods" within the alluvial fan soils, and features of scattered rock, sometimes associated with gray soil masses, had been found associated with these pods. Additional cultural features within both the pods and the relatively unexplored areas between pods were sought because they seemed to have good provenience and comparison would be valuable. Equally important, the gray soil masses were the best source of datable carbon found in the site.

Instead of using remaining funds to excavate more backhoe trenches, another more effective approach was implemented. A backhoe removes soils from the trench in vertical bites, and only the trench wall can be examined; a tractor mounted box blade, however, can be used to scrape a 2 m wide trench in increments usually less than 2 cm thick. This method was therefore employed, and each scrape was examined by an archaeologist on foot (Figure 3-8, Scrape Trenches A-L). The position of each artifact found was marked on the side of the trench with a pinflag, thus identifying the location of artifact concentrations. Two additional rock features and six gray soil masses were found in this manner. In all, 10 scraper trenches (2 m wide), ranging from 11 to 83 m in length and 0.3 to 1.0 m in depth, were excavated in the alluvial soils (a total of 445 m^2).

Unit Excavations

Hand excavation of 1X2 m, and less often, 2X2 m units, was used to test for subsurface deposits as well as to investigate areas that proved to have buried cultural materials. During the exploratory phase of data recovery, at least one 1X2 m unit was placed in each surface locus. As it became evident that surface artifact distribution was not a good indicator of subsurface cultural material, some 1X2 m units were placed between loci in portions of the site with Holocene alluvium. As backhoe trenches began to be cut across the site, the berms of backdirt were walked and pinflagged, and exploratory 1X2 m units were placed adjacent to portions of the trenches that seemed to have some concentration of flakes. These trenches also intersected several gray stains that were treated as features and excavated. In the final phase of heavy equipment use, scrapes with the box blade encountered several concentrations of rock. These were treated as features, exposed, and the deposits in their vicinity excavated.

In most cases, exploratory excavation revealed only limited and diminishing quantities of flakes as the unit deepened. Excavations were not pursued in such areas. While the material recovered from these isolated units are part of the site's assemblage, their relationship to other materials in the site cannot be ascertained, and they are not considered in the quantitative analysis. The results of these excavations are, however, described below.

In four locations, quantities of flakes increased as initial excavation units moved down through 10 cm levels. In these locations, excavation was expanded laterally until flake quantities per level diminished. Each of these four locations is considered a subsurface "component" and is referred to as such to distinguish it from the surface "loci." The treatment and analysis of these components is discussed separately below (Chapter 6); here, we will focus on the data recovery of the surface loci.

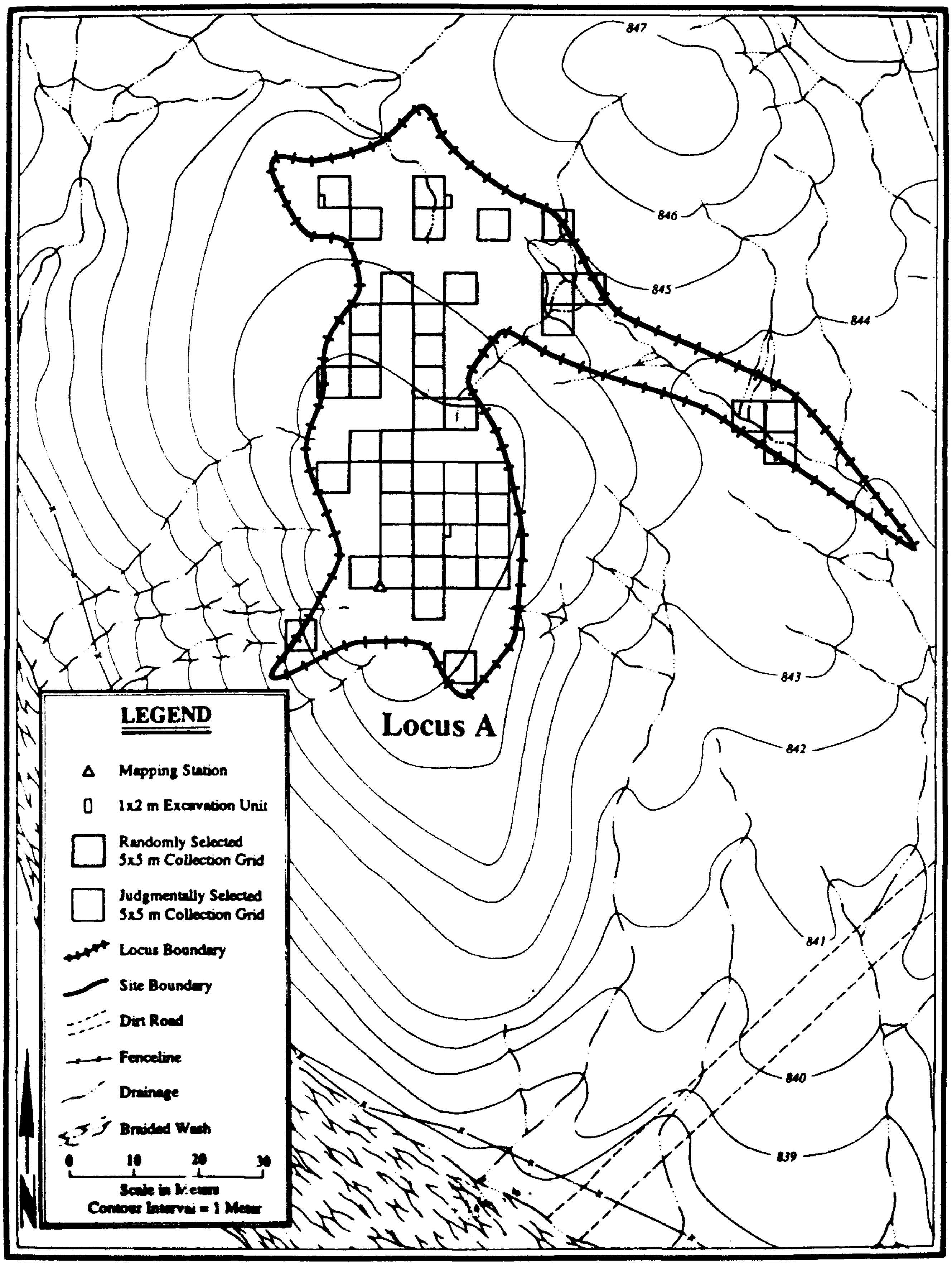


FIGURE 3-10. MAP OF LOCUS A, SITE 4-SBR-4966

Locus A Data Recovery

Locus A, referred to as Locus I in the testing and evaluation phase (Skinner 1984), represents the southernmost artifact concentration of the site (Figure 3-7). It occupies a low knoll of granitic bedrock covered with desert pavement. Cultural material is found on the top of the knoll, scattered down its sides and along a saddle and onto an adjacent knoll of bedrock outcropping. This locus probably contained the most dense concentration of surface artifacts on the Henwood site.

Surface Collection

A 5X5 m grid was used for the surface collection, subdivided into 1 m^2 units to add more control to the provenience. The number of 5X5 m units collected was based on the total allotment for the site relative to the size and importance of the locus. At Locus A, which encompasses 2,400 m^2, 37 5X5 m units were collected, a 38.5% random sample (Figure 3-10). Seven of these were collected by proveniencing the artifacts to each 1X1 m square. The paperwork and time used to provenience to the individual 1 m^2 unit were excessive in relation to the quality of the data collected (for example, no discrete flaking concentrations or features were noted). Therefore, the larger 25 m^2 unit was substituted as the provenience unit for the remainder of the collection. The surface collection effort for Locus A is outlined in Table 3-9. During the collection of the random units, several areas of dense artifact concentrations were noted that did not fall within the random unit selection. A judgmental block of nine 5X5 m units was collected from the area.

Surface scraping was used to detect material slightly below the ground surface. This technique is particularly useful for desert pavements and in areas that have suffered impacts. In Locus A, all randomly selected units received surface scrapes. Only 18 of these 37 shovel scrapes were positive, producing a total of five tools and 28 flakes.

Table 3-9: Results of Surface Collection at Site 4-SBr-4966, Locus A.

Sample Type	Area Collected (m^2)	5X5 m Units	Tools*	Debitage
Random	925	37	207	1,239
Judgmental	225	9	82	423
Total	1,150	46	289	1,662

*Includes cores; excludes ground stone.

Unit Excavations

Four 1X2 m units were excavated in Locus A (Figure 3-10). The results are shown in Table 3-10.

Table 3-10: Results of Excavation at Site 4-SBr-4966, Locus A.

No. of 1X2 m Units	Maximum Depth of Artifacts (cm)	Tools	Debitage	Bone	Ground Stone
4	40	20	185	2	0

Locus B Data Recovery

Locus B was previously referred to as Locus II in the testing and evaluation phase (Skinner 1984). Figure 3-9 shows its position relative to Locus A. Like Locus A, Locus B occupies a low knoll of granitic bedrock along the western margins of the site. Cultural material is found on the higher areas of the knoll in association with a desert pavement formation. Along the margins of the knoll, larger clasts are present, some free and others as embedded outcrop material. The southern and eastern margins of the knoll have been cut away and eroded by a major wash. The erosion has been accelerated by several well-worn tracked vehicle trails which cross-cut the long axis of the locus.

Surface Collection

The sample plan for the Locus B surface collection is detailed on Figure 3-11. The area covered is approximately 1,875 m^2. A 25% random sample of the locus resulted in the selection and collection of 29 5X5 m units. Five judgmentally selected units were added to this random sample. All 34 units were collected by individual 1 m^2 units within the 5X5 m grid. The number and types of items recovered are listed in Table 3-11.

Table 3-11: Results of Surface Collection at Site 4-SBr-4966, Locus B.

Sample Type	Area Collected (m^2)	5X5 m Units	Tools	Debitage	Bone
Random	725	29	112	888	4
Judgmental	125	5	29	250	2
Total	850	34	141	1,138	6

Shovel scrapes were excavated from all 5X5 m units assigned to Locus B. The northeasternmost 1 m^2 was usually designated for surface scrape, but if vegetation or tank impacts were present, another was substituted. Twenty-one of the 34 shovel scrapes produced a total of eight tools and 53 pieces of debitage.

Unit Excavations

Two 1X2 m units were excavated in Locus B (Figure 3-11). The results of these excavations are given in Table 3-12.

Table 3-12: Results of Excavation at Site 4-SBr-4966, Locus B.

No. of 1X2 m Units	Maximum Depth of Artifacts (cm)	Tools	Debitage	Bone	Ground Stone
2	10	6	36	0	1

Locus C Data Recovery

Locus C (Figure 3-12) is a large area that includes Locus III and Locus VII, as designated during the testing and evaluation phase (Skinner 1984: Appendix H, Map 6). This 47,200 m^2 area is also the most severely impacted section of the site. It lies 80 m northwest of Locus B, and the western margin of the locus is coincident with the western site boundary, a large wash. The surface of the locus is flat but cut by many rills and small arroyos. These erosional processes have been accelerated due to target and tracked vehicle use. Geologically, this section of the site is most exemplary of the juncture of the stream terrace deposits with the northwest-southwest trending alluvial fan deposits (Bachhuber 1983). In Locus C, the fan deposits are thin, as evidenced by the calcic soils which cap the stream deposit at a depth of

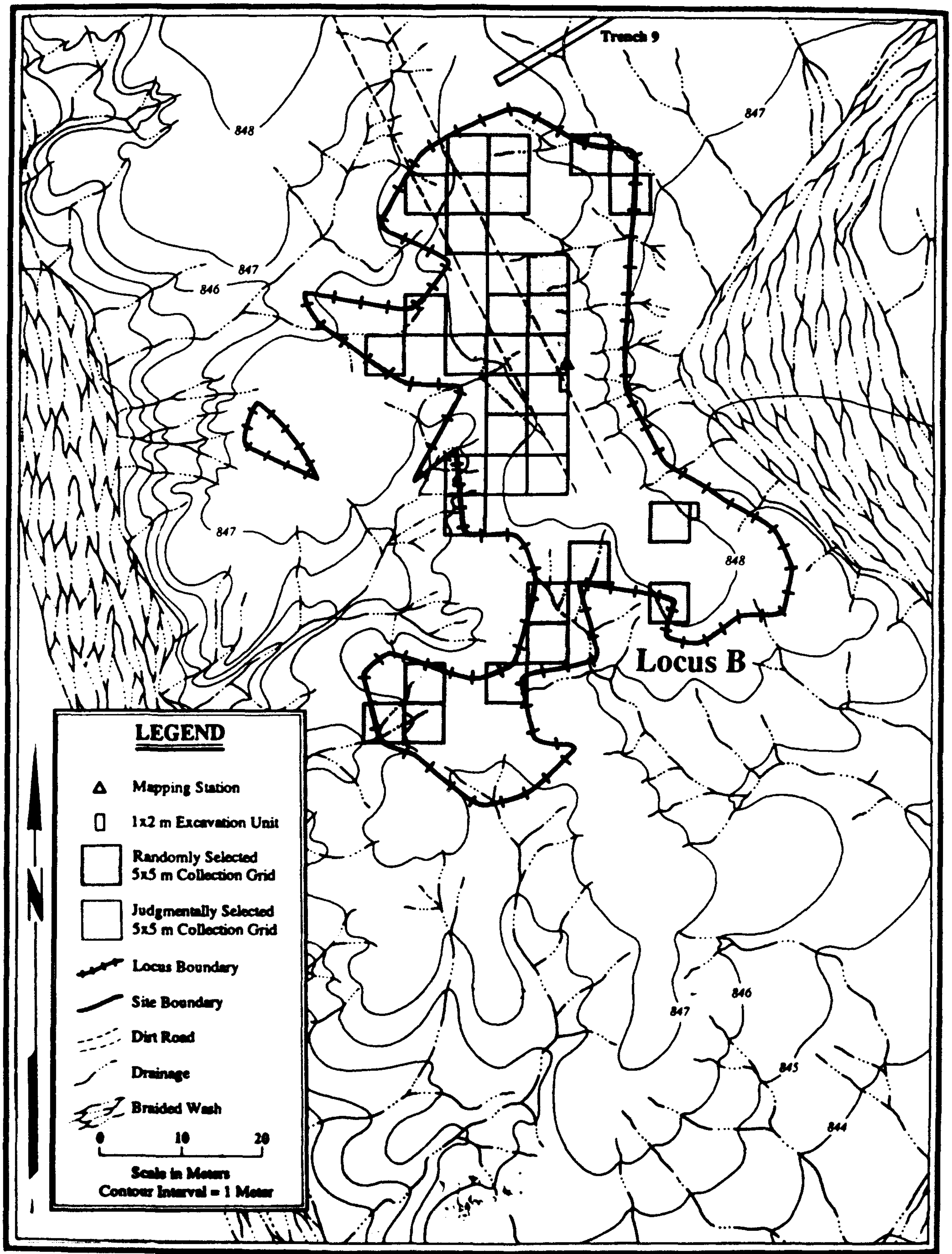


FIGURE 3-11. MAP OF LOCUS B, SITE 4-SBR-4966

10-15 cm. Along the western edge of the locus, a few small knolls show a well developed desert pavement surface containing artifactual material (Concentrations 4, 5, and 6).

Surface Collection

After pinflagging Locus C, it was evident that dense artifact concentrations occurred within areas of light to moderate density. To sample the surface of such a large area, two crew members identified the densest concentrations and flagged the boundaries. Each of these was treated as a separate entity for selection of the surface collection sample. Nine sampling strata were thus delineated (Figure 3-12). These are:

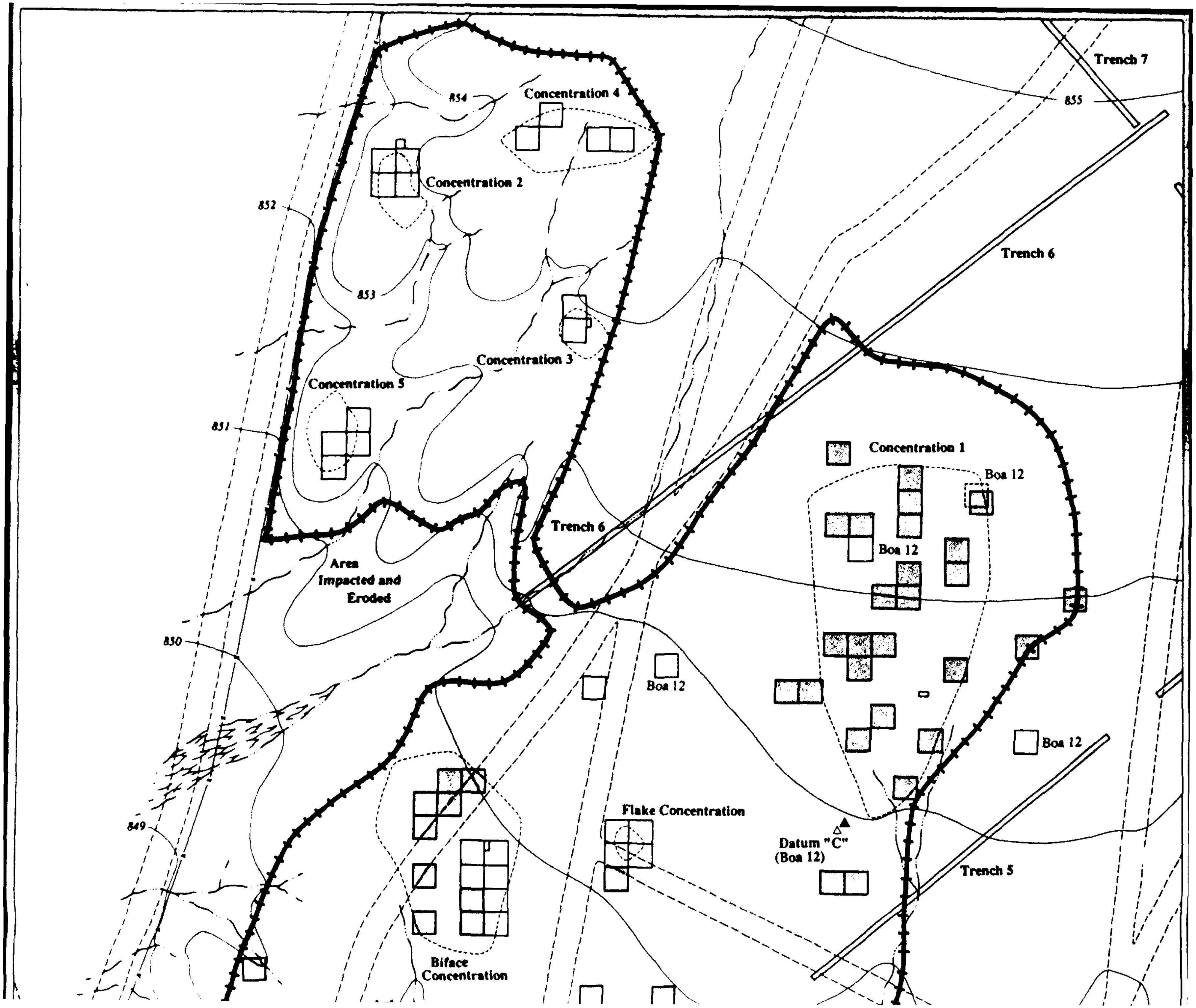
1. Concentration 1, a dispersed, moderate density lithic scatter with a few tools, located in the northeastern portion of Locus C. Unlike other concentrations, materials are found on a thin deposit of recent alluvial deposits, but the concentration showed no subsurface cultural materials. Twenty 5X5 m units constituting a simple random sample were collected.

2. Concentration 2, a more limited moderate density lithic scatter located in the southernmost part of Locus C on a surface of eroded old alluvial sediments (Unit C). Four 5X5 m units were allocated according to a simple random sample, and an additional 4 were placed judgmentally in an area of artifact concentration.

3. Concentrations 3, 4, 5, and 6, each small, low density lithic scatters, confined to remnant patches of desert pavement formed on fluvial gravels in the northwest section of the locus adjacent to Nelson Wash. Fourteen 5X5 m units were placed judgmentally within these four concentrations, and they are combined for consideration in the quantitative analysis below.

4. The Flake Concentration, probably a discrete chipping station with a small dense concentration of debitage in the central part of the locus. The flakes showed some local redistribution in the erosion channels that affect this portion of the site. The surface deposits are old soil. The Flake Concentration was collected in four contiguous 5X5 m units.

5. The Biface Concentration, an area in which pinflagging revealed an unusual number of bifaces in a constricted area adjacent to the Flake Concentration (4). Materials were on the surface of old soil. Nine 5X5 m units were collected as a simple random sample. Six additional 5X5 m units were placed judgmentally to complete a block of contiguous units.



Trench 7
855
Trench 6
Concentration 4
Concentration 2
852
853
854
Concentration 3
Concentration 5
851
Concentration 1
Boa 12
Boa 12
Trench 6
Area
Impacted and
Eroded
850
Boa 12
Boa 12
849
Flake Concentration
Datum "C"
(Boa 12)
Trench 5
Biface
Concentration

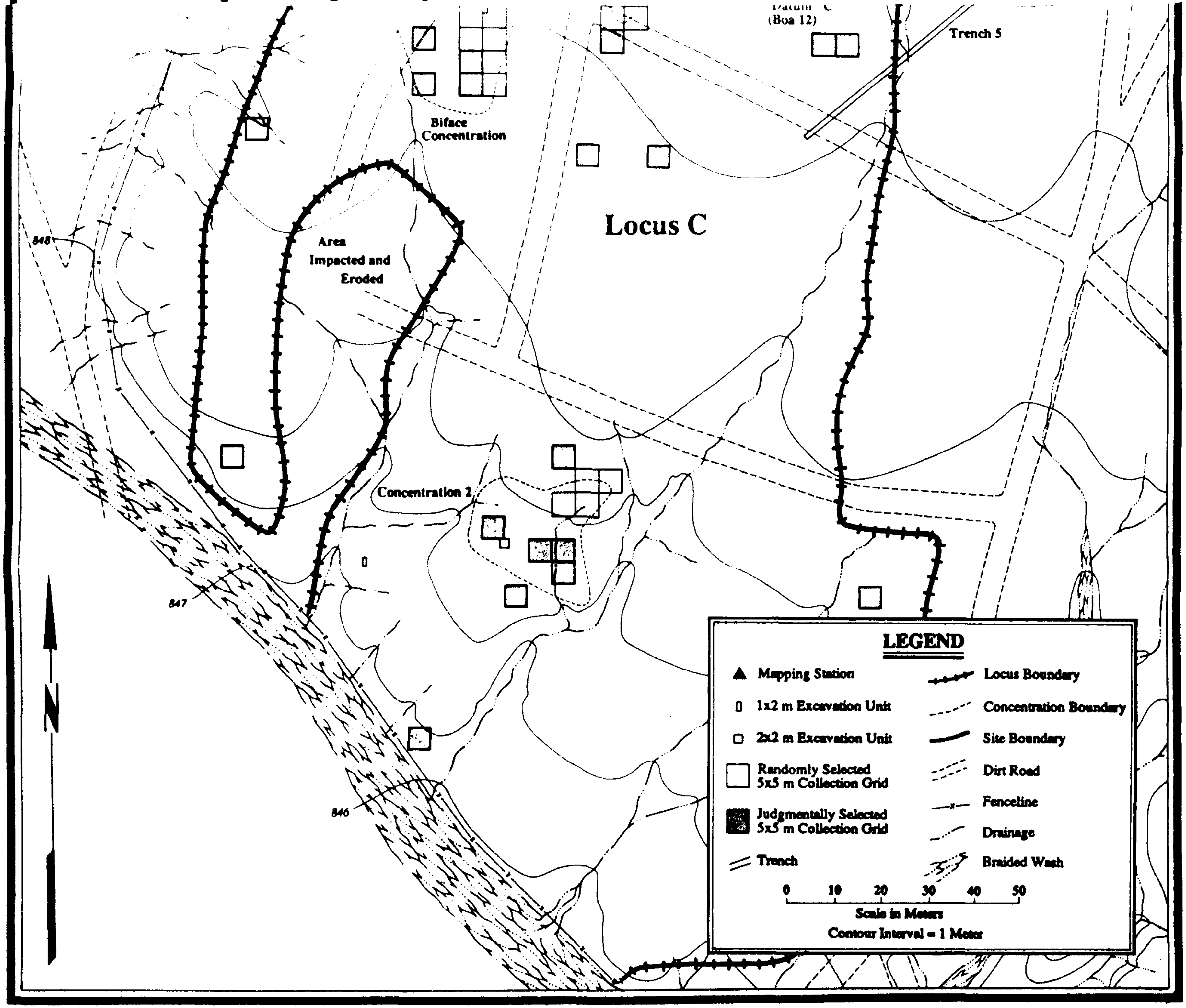


FIGURE 3-12. MAP OF LOCUS C, SITE 4-SBR-4966

2

6. The remaining areas of Locus C were designated the Low-Moderate Density Area, and 17 5X5 m units were distributed over it as a simple random sample and collected.

The sample type and the number of 5X5 m units collected in each of these strata, along with the quantity of types of artifacts recovered, are presented in Table 3-13.

Table 3-13: Results of Surface Collection at Site 4-SBr-4966, Locus C.

Concentration	Area* (m^2)	Sample Type	Percent of Area Collected	5X5 m Units	Tools	Debitage
1	1,950	Random	25.6	20	20	237
2	400	Random	25.0	4	12	176
		Judgmental	25.0	4	22	105
3	85	Judgmental	58.8	2	7	34
4	275	Judgmental	36.3	4	33	82
5	90	Judgmental	100.0	4	5	36
6	75	Judgmental	100.0	4	13	15
Flake	100	Judgmental	100.0	4	10	237
Biface	775	Random	29.0	9	49	130
		Judgmental	19.3	6	20	64
Low-Mod	43,450	Random	1.9	17	6	159
Total	47,200			78	197	1,269

*Approximate

Forty-one shovel scrapes were selected judgmentally for the 5X5 m units at Locus C. Eighteen of these contained cultural material, resulting in a total of two tools and 55 pieces of debitage. Table 3-14 lists the surface scrapes and material recovered from each concentration.

Table 3-14: Results of Shovel Scrapes at Site 4-SBr-4966, Locus C.

Concentration	Sample Type	Shovel Scrapes*	Tools	Debitage
1	Random	10/4	0	13
2	Random	2/0	0	0
	Judgmental	1/0	0	0
3	Judgmental	1/1	0	5
4	Judgmental	2/0	0	0
5	Judgmental	2/1	0	1
6	Judgmental	1/0	0	0
Flake	Judgmental	1/1	2	20
Biface	Random	5/2	0	2
	Judgmental	0/0	0	0
Low-Moderate	Random	17/9	0	14
Total		41/18	2	55

*Total number/number with cultural material.

Unit Excavations

Excavations at Locus C were carried out in the various concentrations identified during the surface collection effort (Figure 3-12). One 1X2 m unit was excavated in Concentration 1, two in Concentration 2, and one each in Concentration 3 and the Biface Concentration and Low-Moderate Density areas. An additional 2X2 m unit was excavated at the northern end of Locus C to examine a potential rock cairn. Table 3-15 summarizes the results of excavation in Locus C.

Locus D Data Recovery

Locus D (Figure 3-13), identified as Locus IV by Skinner (1984: Appendix H, Map 6), is found near the center of the site, on a slight rise adjacent to Halfway Wash. The area is covered by a thin veneer of old soil; the whitish caliche cap of the stream terrace deposit is apparent immediately below the surface.

Table 3-15: Results of Excavation at Site 4-SBr-4966, Locus C.

No. of 1X2 m Units*	Maximum Depth of Artifacts (cm)	Tools	Debitage	Bone	Ground Stone
4	40	20	185	2	0

*One 2X2 m unit is counted as two 1X2 m units.

Surface Collection

Locus D was not pinflagged for the surface collection effort; boundaries drawn for the evaluation phase (Skinner 1984: Appendix H, Map 6; Map 13) were used for the sake of efficiency. The western edge of Locus D was excluded, however, due to the lack of cultural material in that area. Twenty-six 5X5 m units were surface collected from Locus D (Table 3-16). Thirteen shovel scrapes were excavated in Locus D, six of which produced a total of 25 flakes.

Table 3-16: Results of Surface Collection at Site 4-SBr-4966, Loci D, E, and F.

Locus	Area* (m^2)	5X5 m Units	Tools	Debitage
D	300/862	26	23	612
E	200/1,100	23	11	587
F	380/875	28	26	383
Total	850/2,837	77	60	1,582

*Skinner (1984) locus area/data recovery locus area.

Unit Excavations

The number of units excavated in Locus D as well as the artifacts found in them are listed in Table 3-17.

Table 3-17: Results of Excavation at Site 4-SBr-4966, Loci D, E, and F.

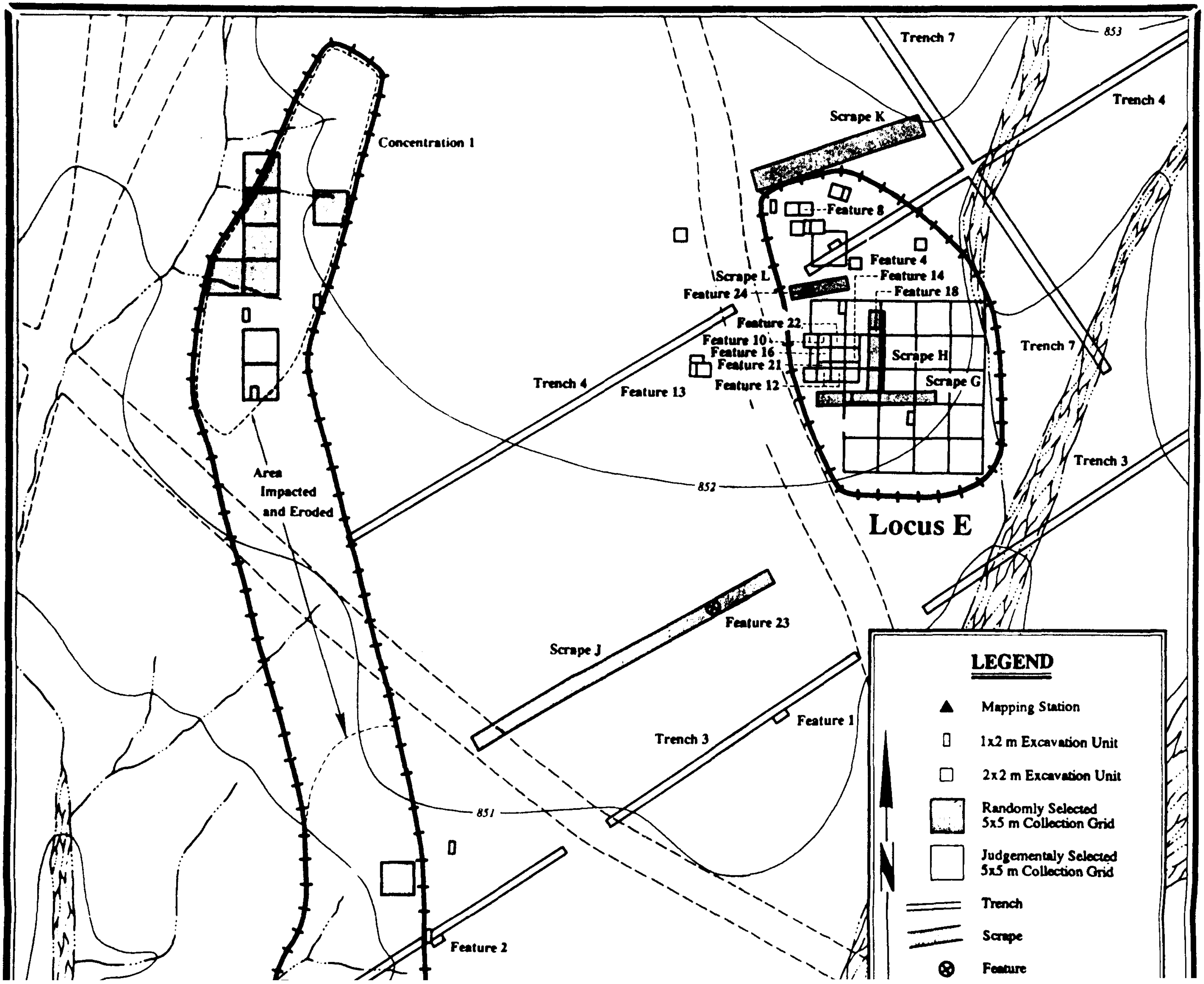
Locus	No. of 1X2 m Units	No. of 1X2 m Units	Maximum Depth of Artifacts (cm)	Tools	Debitage	Bone	Ground Stone
D	2	0	40	2	83	0	0
E	11	18	80	120	19,277	689	6
F	5	0	70	4	255	1	0
Total	18	18		126	19,615	690	6

Locus E Data Recovery

Locus E (Figure 3-13), identified as Locus V by Skinner (1984: Appendix H, Map 6), is located to the north and east (up slope) from Locus D. Substantial deposits of Holocene fan alluvium are present here and the sediments are sandy with gravel-sized clasts of granitic material. No desert pavement surface occurs at this locus. Locus E also proved to have extensive subsurface materials, described below.

Surface Collection

The boundaries of Locus E drawn during the evaluation phase (Skinner 1984: Appendix H, Map 6; Map 15) was used for the data recovery effort. Surface materials were collected in 26 5 X 5 m units, a 100% sample of the original area (Vaughan 1984:45-46; Skinner 1984: Appendix



Trench 7
Trench 4
Scrape K
Concentration 1
Feature 8
Feature 4
Feature 14
Feature 18
Scrape L
Feature 24
Feature 22
Feature 10
Feature 16
Feature 21
Feature 12
Scrape H
Scrape G
Trench 7
Trench 4
Feature 13
Trench 3
852
Locus E
Area
Impacted
and Eroded
Scrape J
Feature 23
Feature 1
Trench 3
851
Feature 2
853
LEGEND
Mapping Station
1x2 m Excavation Unit
2x2 m Excavation Unit
Randomly Selected
5x5 m Collection Grid
Judgementaly Selected
5x5 m Collection Grid
Trench
Scrape
Feature
N

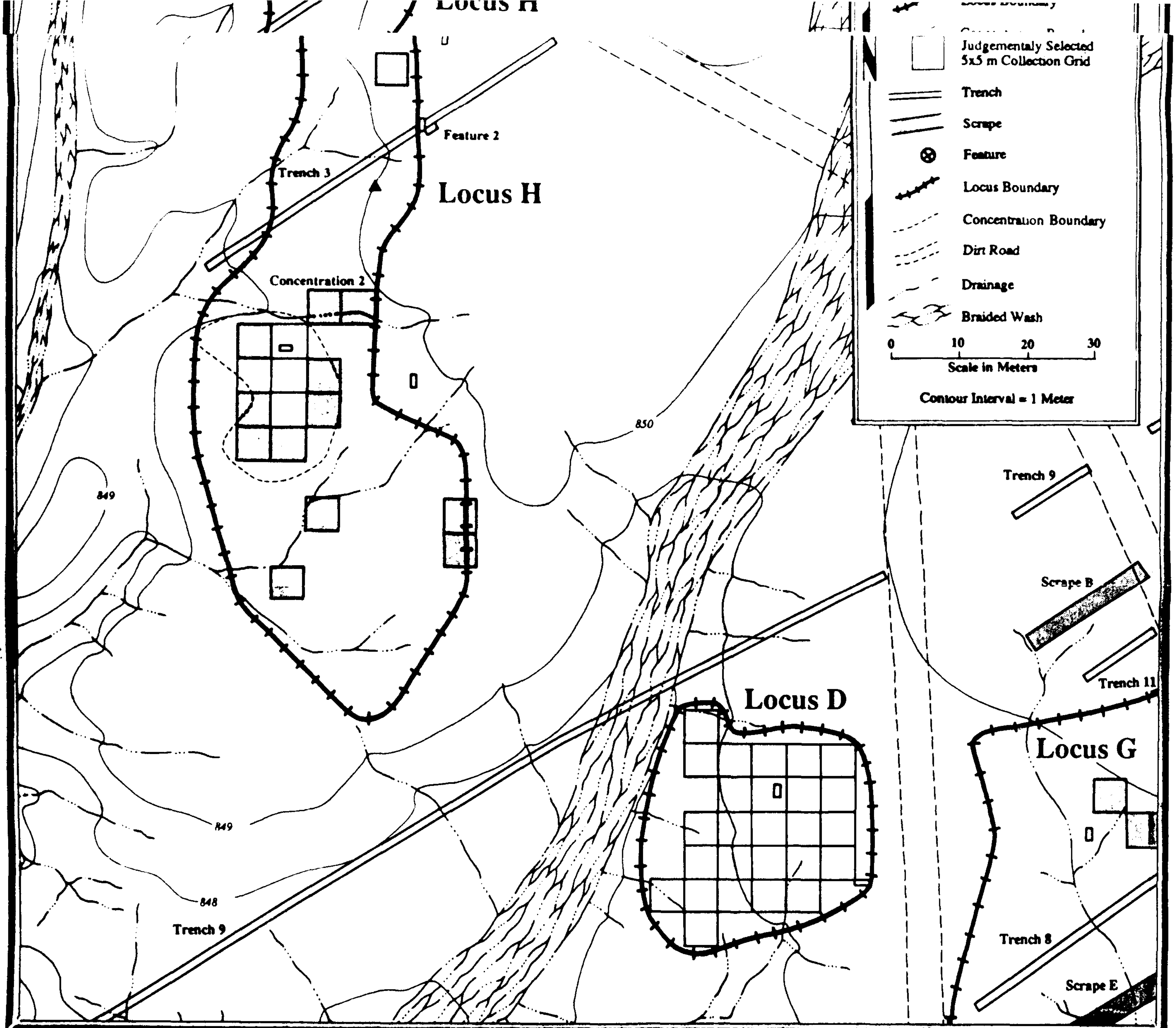


FIGURE 3-13. MAP OF LOCI D, E AND H, SITE 4-SBR-4966

H, Map 6). However, the excavation effort demonstrated that Locus E was larger than originally drawn. The results of the surface collection at Locus E are shown in Table 3-16. Eleven shovel scrapes were also screened, 10 of which produced 48 flakes.

Unit Excavations

Eleven 1X2 m and 18 2X2 m units were excavated in Locus E (Figure 3-13) due to the discovery of features and ground stone in and to the north of Trench 4. A block excavation consisting of 14 excavation units was opened and the content of this area below the depth of 10 cm was considered Component 2. Several cultural features and a hearth area were identified. Cultural deposition in Locus E was continuous from the surface to a depth of 65 cm. Features were encountered between 10 and 40 cm, although some continued to a depth of 65 cm. In addition to the 14 unit excavation block of Component 2, 15 other units were excavated in Locus E. Results of excavation are given in Table 3-17. Component 2 is a complex area. It included six features: four localized concentrations of gray soil (Features 10, 14, 21, and 22); a cache of flakes (Feature 16); and a hearth associated with a gray stain (Feature 12). Ferraro (personal communication 1984) suggests that the features occurred in two levels, judging from the profiles. In four non-adjacent excavation units, S1455 E2011, S1455 E2015, S1457 E2015 and S1459 E2011, vertical flake distributions exhibit two highs per unit, one at 10 or 20 cm and the second at 40 cm.

Soil stratification, or, more accurately, the lack of it, prevented excavation by depositional units within Component 2. The matrix of Component 2 is gravelly, sandy, recent alluvial sediment of Unit B. In the quantitative analysis, the internal distributions of materials in the component will be examined before deciding whether it should be divided into two analytic units. The sediments that include Component 2 are considered to be slightly younger than those in which Component 1, Locus G, was encountered.

Locus F Data Recovery

The boundary of Locus F (Figure 3-14) drawn for the evaluation phase (Skinner 1984: Appendix H, Map 6) was used during data recovery. Locus F, identified as Locus VI by Skinner (1984: Appendix H, Map 6), is located to the south, along the eastern margin of the site at the base of a fan. It is a restricted concentration of surficial materials in an area of thin alluvial deposits and did not yield substantial subsurface deposits.

Surface Collection

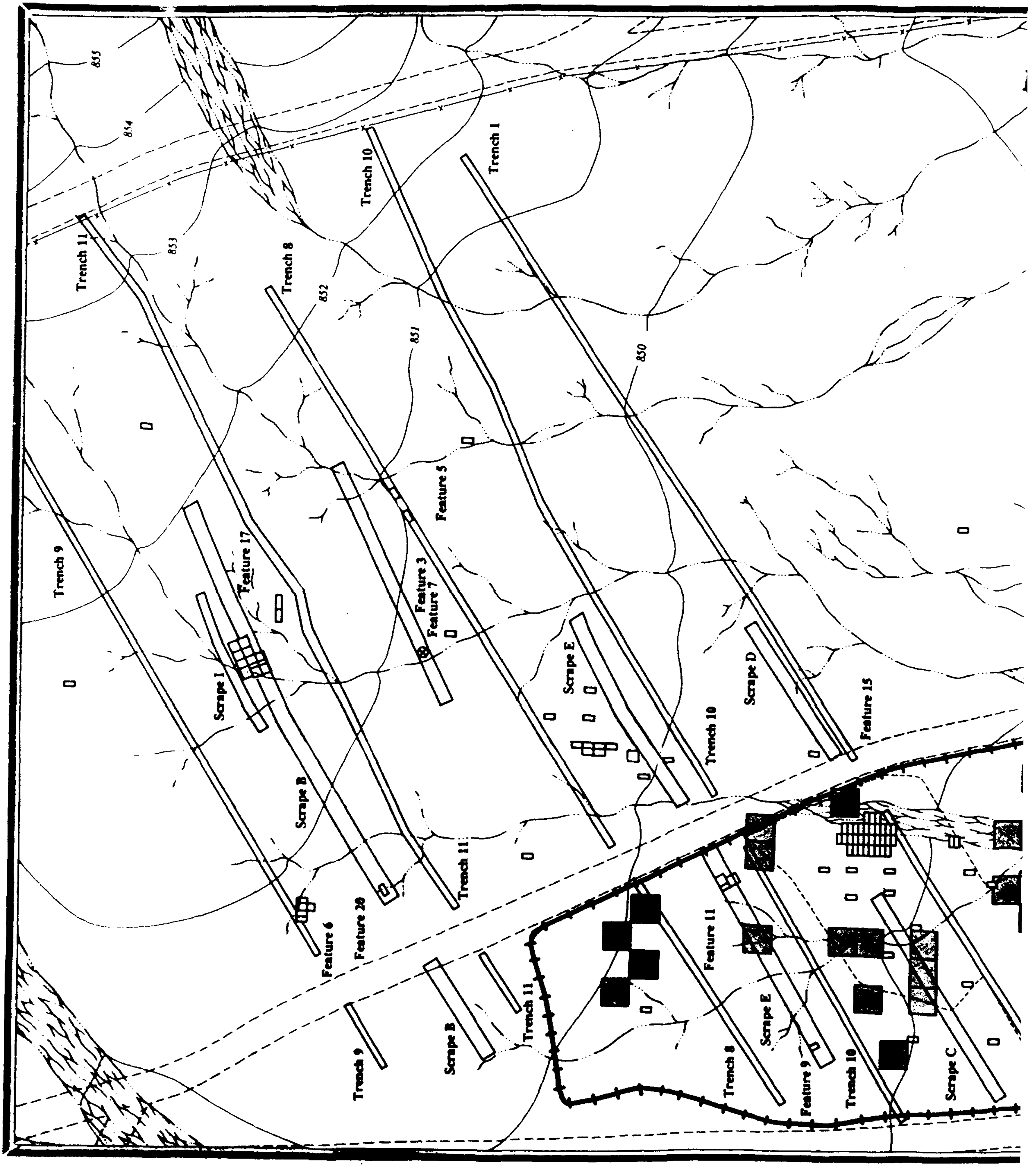
A 100% sample, twenty-eight 5X5 m units (Table 3-16), was collected and 13 surface scrapes were shoveled and screened, 11 of which produced 25 flakes and three tools (Vaughan 1984:45-46).

Unit Excavations

Five 1X2 m units were excavated in Locus F. Only four tools were recovered, but debitage was found to a depth of 70 cm. The results of the excavation in Locus F are summarized in Table 3-17.

Locus G Data Recovery

The excavation of backhoe Trench 1 (Figure 3-8) resulted in the discovery of Locus G (Figure 8-14). Near the east end of Trench 1 in this area, a metate and several metabasalt flakes were unearthed by the backhoe. A crew was sent to pinflag around the trench and a Lake Mojave and a Pinto projectile point were found. Pinflagging efforts were then expanded to the north, east, and south of the trench. The north and south boundaries of Locus G were determined by a light flake scatter, whereas a dense scatter was found in the central area of the locus. Dirt roads were used to arbitrarily mark the east and west boundaries of the locus. Cultural material continued past the eastern road, but in lesser quantities.


855
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Trench 11
Trench 10
Trench 1
Trench 8
Trench 9
Feature 17
Feature 5
Feature 3
Feature 7
Scrape I
Scrape E
Scrape D
Feature 15
Trench 10
Scrape B
Trench 11
Feature 20
Feature 6
Feature 11
Scrape E
Trench 8
Feature 9
Trench 10
Scrape C
Trench 9
Scrape B
Trench 11

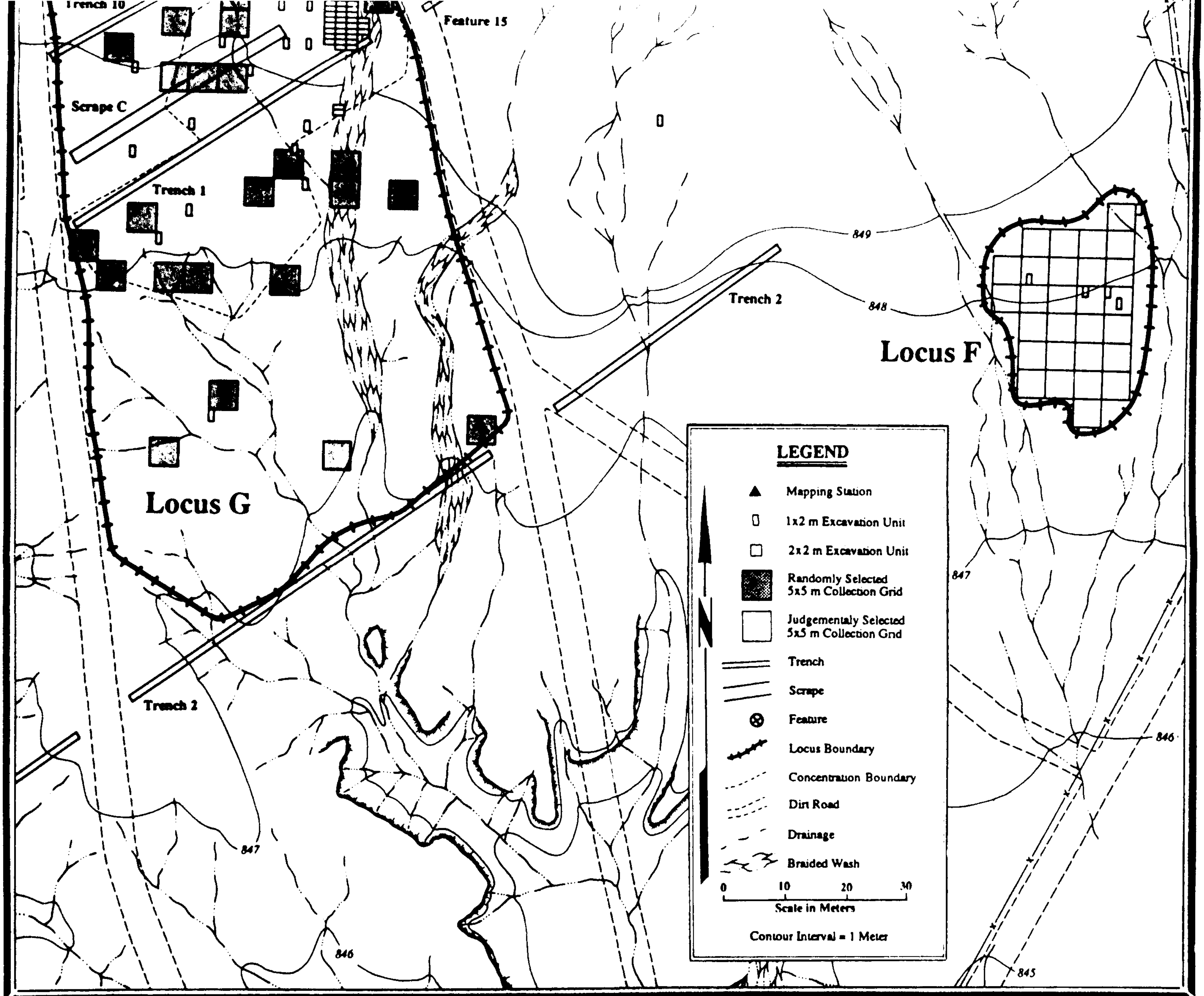


FIGURE 3-14. MAP OF LOCI F AND G, SITE 4-SBR-4966

2

Surface Collection

The central portion of the locus was called the High Density Area and the remainder termed Moderate Density. The two were treated as separate strata for allocating the sample of surface units, and 17 5X5 m units, constituting a 21.7% simple random sample of the surface of the High Density Area, were collected. A lower sampling fraction of 5% was allocated to the Moderate Density Area, and 13 5X5 m units were collected as a simple random sample. Shovel scrapes were excavated in every other 5X5 m unit (Vaughan 1984:46-47). Table 3-18 shows the area, sample size and quantity of material recovered from this collection effort.

Table 3-18: Results of Surface Collection at Site 4-SBr-4966, Locus G.

Concentration	Area (m^2)	Sample Type	Percent of Area Collected	5X5 m Units	Tools	Debitage
High Density	2,200*	Random	21.7*	17	16	162
Moderate	6,300	Random	5.0	13	1	77
Total	8,500			30	17	239

*Approximately 250 m^2 was deleted from the sampling frame due to trench cut and spoil pile areas. The area figure reflects the total area of high density including the trench cut, but this disturbed area is excluded from the percent of area sampled.

Unit Excavations

The excavations placed in Locus G provided the most extensive and intensive subsurface data recovery effort at the Henwood site. After the excavation of Trench 1 unearthed ground stone and debitage, excavation units were spaced alongside the trench to determine the area or areas of densest subsurface deposit. One such area, Component 1, was identified and a block of excavation units was opened to investigate it. The results of the excavation units placed in

Locus G are presented in Table 3-19 together with the results of excavations from Locus H and Locus I.

Table 3-19: Results of Excavation at Site 4-SBr-4966, Loci G, H, and I.

Locus	No. of 1X2 m Units	No. of 1X2 m Units	Maximum Depth of Artifacts (cm)	Tools	Debitage	Bone	Ground Stone
G	51	3	110	102	12,897	394	4
H	7	0	90	1	156	63	0
I	4	0	30	10	33	0	0
Total	62	3		113	13,086	457	4

Thirty-one contiguous units were excavated, bounded by grid lines S1676, S1687, E2083 and E2091. The contents of these units below 10 cm depth are considered as comprising Component 1. Materials from nearby units are perhaps also related to Component 1, but the deposits are shallower and material frequencies lower. Since the nature of their relationship is uncertain, they are excluded from the Component 1 definition. The distribution of materials in Component 1 has all the characteristics of a single deposition. Highest flake frequencies are found in its central part, and they drop away in all directions. High flake counts generally coincide with the distribution of a scatter of fragments of granitic rocks at about 30-40 cm in the central part of the component. When flaked distributions from the units are inspected for vertical distribution, they show a unimodal curve, usually peaking at about 40 cm and diminishing above and below.

Component 1 also included Feature 15, a circular gray-stained area, which was centrally located in the component in the area of high flake counts at a depth of 28 to 58 cm. The congruent distributions of granitic rocks and high flake counts with which Feature 15 coincides is taken to indicate that this association is an original, cultural one, even though the materials have been

locally redistributed. The matrix of Component 1 is the gravelly, sediment of Unit B, and the walls of Trench 1 adjacent to the component show that here as elsewhere, this sediment's deposition was the combined result of many small cuts and fills.

Locus H Data Recovery

Locus H (Figure 3-13) is located between Locus C and Locus E in the north-central area of 4-SBr-4966. This area is heavily dissected by rills and a small wash runs north-south through the southern section of the locus. Geologically, Locus H is similar to Locus C; the area is covered by a thin alluvial fan deposit underlain by stream terrace deposits. From north to south, the fan deposit thins out. Eventually, at the south end of the locus, the whitish calcic horizon appears on the surface.

Surface Collection

Black metabasalt is the predominant lithic material found at the site but chert and chalcedony artifacts were found in greater quantity in Locus H than in other loci at the site, with the exception of Locus E. Because of the potential for identifying manufacturing techniques, which may differ between chert/chalcedony and metabasalt, all cryptocrystalline quartz flakes and tools not collected in the 5X5 m surface grids were provenienced and recovered individually as transit shot items.

Pinflagging in this area revealed that Locus H forms a linear configuration. Two areas of concentration were identified within it. The first of these, Concentration 1, represents a moderate density scatter separated by a center strip which has suffered some military impacts. This impact area of 750 m^2 was excluded from the 5X5 m surface collection sample are. Both areas (Concentration 1-south and Concentration 1-north) were considered separate sampling units for purposes of selecting the random sample for surface collection. Concentration 2 was identified as a tight cluster of flakes within the larger Concentration 1-south area. It was sampled as a distinct entity. In Table 3-20 the area, sample size and the quantity of material

recovered are given for the surface collection effort from each concentration. A judgmental sample consisting of four 5X5 m units was added to Concentration 2 after the 50% random sample had been collected, as a large part of the flake scatter was missed by the randomly selected 5X5 m units. All surface collection units were provenienced to the 1X1 m subdivisions within the 5X5 m grids.

Thirteen shovel scrapes were excavated from Locus H: four each from the two Concentration 1 areas, one from the Concentration 2 area, and four from the judgmentally placed units. Five flakes were recovered from four of the shovel scrapes.

Table 3-20: Results of Surface Collection at Site 4-SBr-4966, Locus H.

Concentration	Area (m^2)	Sample Type	Percent of Area Collected	5X5 m Units	Tools	Debitage
1-north	600	Random	33.3	8	13	266
1-south	2,175	Random	8.0	7	1	58
2	300	Random	50.0	6	23	175
		Judgmental	33.3	4	25	248
Total	3,075*			25	62	747

*Total area excludes the 750 m^2 impacted area.

Unit Excavations

Seven 1X2 m units were excavated in Locus H and showed a maximum depth of 90 cm, but produced only one tool. The results of excavation at Locus H are summarized in Table 3-19.

Locus I Data Recovery

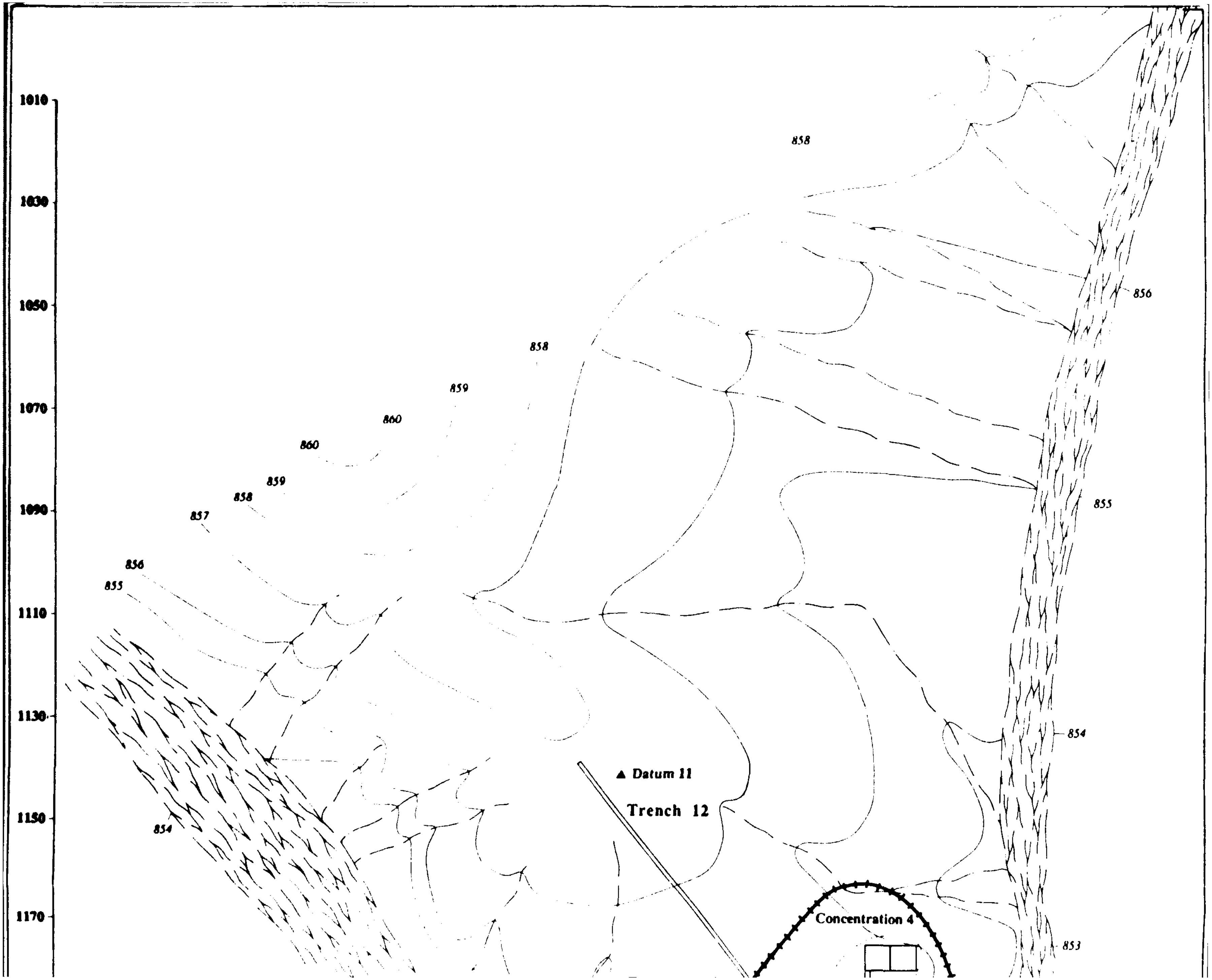
An interfluvial ridge dividing Nelson Wash lies to the northwest of, and is detached from, the contiguous portion of 4-SBr-4966. The composition and elevation of the deposits of this ridge, the types of raw material present, and tool and debitage forms resemble those of the main portion of the Henwood Site. Therefore, the artifact bearing portion of the interfluvial ridge is designated Locus I of the Henwood site (Figure 3-15). Cultural material is found on a series of small, low benches with well developed desert pavement and on the lower, sandy gravel areas between the terraces.

After pinflagging, four concentrations of cultural material were identified, encompassing 1,875 m^2 of the 9,000 m^2 locus area. The four concentrations were combined for the selection of a simple random sample. Twenty-five 5X5 m units were selected, comprising 33.3% of the area of the four combined concentrations. Table 3-21 lists the surface collection information by concentration.

Table 3-21: Results of Surface Collection at Site 4-SBr-4966, Locus I.

Concentration	Area* (m^2)	5X5 m Units	Tools	Debitage
1	200	2	5	26
2	175	2	1	35
3	1,300	18	8	75
4	200	3	8	58
Total	1,875	25	22	195

*Approximate.


1010
1030
1050
1070
1090
1110
1130
1150
1170
858
856
858
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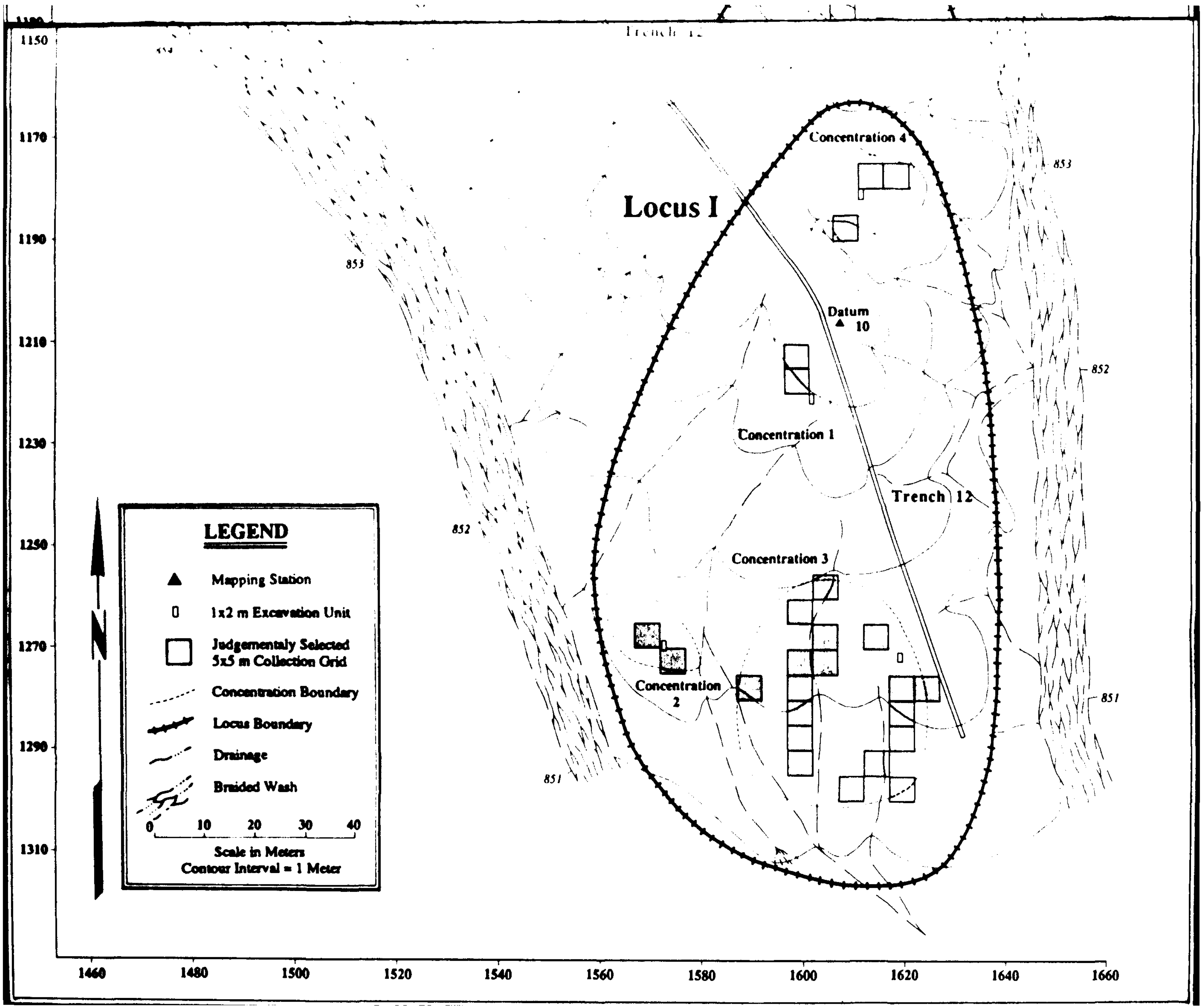
856
855
855
854
854
853
▲ Datum 11
Trench 12
Concentration 4



Locus I
Concentration 4
Datum
10
Concentration 1
Trench 12
Concentration 3
Concentration
2
853
852
851
LEGEND
Mapping Station
1x2 m Excavation Unit
Judgementaly Selected
5x5 m Collection Grid
Concentration Boundary
Locus Boundary
Drainage
Braided Wash
0
10
20
30
40
Scale in Meters
Contour Interval = 1 Meter
N
1150
1170
1190
1210
1230
1250
1270
1290
1310
1460
1480
1500
1520
1540
1560
1580
1600
1620
1640
1660

Shovel scrapes were excavated from each concentration: one each in Concentrations 1 and 2, nine in Concentration 3, and two in Concentration 4. Seven flakes and one tool were recovered from seven of these scrapes.

Unit Excavation in Nonlocus Areas

In addition to the excavations from the nine loci, 37 1X2 m and 15 2X2 m units were excavated in the nonlocus section of the site (shown on Figure 3-10 through 3-15). This area encompasses approximately 329,113 m^2 and includes everything outside the locus boundaries, with the exception of the impacted area southwest of Locus I. For the most part, excavation units were located to investigate features or artifact concentrations found during the trenching operations. Also, several units were excavated in areas with little or no surface cultural material. This was to assess the possibility of subsurface deposits in areas without surface indications. Table 3-22 presents the nonlocus excavation information. For ease in locating the excavations, the units are listed in relation to the closest locus, "scrape," or trench excavation. The 1X2 m and 2X2 m units were hand excavated adjacent to the trenches in areas where high density cultural remains were discovered during trenching operations.

Excavations at Component 3

Feature 17 was encountered in Scrape B by the box blade excavation. Fourteen contiguous units were then excavated in the course of exploring the matrix of the feature. Feature 17 proved to be a scatter of large granitic rocks about 40 cm below the surface. All cultural materials from below 30 cm in units bounded by gridlines S1567, S1675, E2111 and E2119 are considered to form Component 3. Flake counts from these units show diminishing quantities as one moves from the center of the excavation to its periphery. No gray stained areas were encountered in Component 3, but here, as in Component 1, we have apparently congruent distributions of large angular fragments of granitic rocks and flakes. Excavation units penetrated to depths of 60 to 70 cm, and flakes show unimodal vertical distribution with the highest counts at 40 to 60 cm.

Table 3-22: Results of Excavation at Site 4-SBr-4966, Nonlocus Areas.

Locus or Trench* Adjacent to Unit	No. of 1X2 m Units	No. of 1X2 m Units	Maximum Depth of Artifacts (cm)	Tools	Debitage	Bone	Ground Stone
Locus A	2	0	10	1	15	0	0
Trench 1	1	0	50	2	112	6	0
Scrape E[1]	10	1	80	6	1,687	203	1
Trench 10	1	0	60	1	11	4	0
Trench 8	5	0	80	4	392	27	0
Trench 11	3	0	100	3	370	9	0
Scrape B[2]	3	12	80	25	5,704	207	1
Trench 9	6	0	50	1	503	5	1
Trench 3	1	0	70	0	23	1	0
Trench 4	2	2	50	5	181	20	0
Trench 7	2	0	10	0	4	0	0
Total	37	15	640	48	9,002	482	3

*Numbered trenches are backhoe excavations; lettered "scrapes" are box blade excavations.
[1]Component 4.
[2]Component 3.

No concentration of surficial materials was discerned in the vicinity, and Component 3 falls in a nonlocus portion of the Henwood site (4-SBr-4966). Sediment in this area of the site is the gravelly Holocene alluvium of Unit B. In the quantitative analysis below, materials from Component 3 are considered a single analytical unit.

Excavations at Component 4

Cultural materials from below 30 cm in six contiguous units bounded by grid lines S1628, S1636, E2099 and E2101 are included in Component 4. Flake densities in Component 4 are less

than in other components. They peaked at depths of 50 to 60 cm, and units generally penetrated to 70 or 80 cm below the surface. The matrix of Component 4 is the gravelly Holocene alluvium of Unit B. Cultural materials from the excavation units in Component 4 are considered as a single unit in the quantitative analysis. No concentration of surface materials was found in the vicinity of Component 4, and it falls in a nonlocus portion of site 4-SBr-4966.

Summary of Henwood Site (4-SBr-4966) Surface Sample

As a result of the mix of random, judgmental and 100% samples that were collected from selected portions of the site, counts of artifacts and flakes must be used with caution in quantitative analysis. They bear the same limits to their comparability that the surface samples from the small sites do. In addition, it should not be forgotten that the entities, loci and concentrations within loci, were what was sampled. There is no sample or composite of samples that can be taken as representing the surface of the site as a whole. The loci together comprise about 16.6% of the total site area. The 83.4% of the site falling outside the loci was not sampled by surface collection controlled by grids in either the testing and evaluation or data recovery phases (Vaughan 1984:50). Densities of flakes from these areas remain unestimated. The distribution of transit-provenienced tools from the evaluation and data recovery phases of work demonstrate that 4-SBr-4966 was indeed a site with a continuous distribution of cultural material over its surface, and not simply eight separate sites grouped for convenience.

CHAPTER 4 - ARTIFACT DESCRIPTIONS

INTRODUCTION by Claude N. Warren

An artifact typology most often communicates a description of artifact classes based on selected "important" attributes. Such a typology may be used as the basis for seriation and chronological placement, for functional categories, for illustrating "culture change," and then be said to represent the "mental template" of the makers of the artifacts. It should not be surprising that such typologies do not function well in all of these endeavors.

In this study, it is assumed that types are conceptual tools of the archaeologist, that they work best when designed for specific tasks, that more than one taxonomic system may be required to answer the questions the archaeologists ask (or to test hypotheses), and that whether or not the types represent the "mental template" of the makers of the artifacts is irrelevant in most instances. To distinguish between several taxonomies and apply different "typologies" to different problems as needed should be a common practice for archaeologists.

PROJECTILE POINT TYPOLOGY by Claude N. Warren

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instances. To distinguish between several taxonomies and apply different "typologies" to different problems as needed should be a common practice for archaeologists.

PROJECTILE POINT TYPOLOGY by Claude N. Warren

In the Mojave Desert, typological cross dating has been based on "traditional" types of projectile points, and secondarily on "traditional" types of other artifact categories. Ideally, traditional types are defined on the bases of time sensitive clusters of attributes, but in reality no such no such attribute clusters have been identified for the Mojave Desert and the traditional artifacts types have been intuitively defined. Consequently, archaeologist have not been consistent in their type descriptions and there are disagreements as to which attributes are "characteristic" of any given type. Most of the projectile points in the Nelson Wash assemblages fall withing the traditional Lake Mojave, Silver Lake, and Pinto types. All other types are represented by a single or small number of specimens. The chronological types developed here are an attempt to identify and objectively describe the attributes by which the traditional types can be defined. The artifact types described here are designed to convey to the reader the form of the artifact and in that sence are descriptive types. In the case of the Pinto and Lake Mojave series, the descriptions also describe attribute clusters that we postulate to be time sensivive and therefore describe chronological types.

To achieve this end we have followed Thomas' (1970; 1981) taxonomic methods, but use attributes based on the descriptions of the traditional point types of the Mojave Desert. Nearly all of the points of the Lake Mojave and Pinto series defined here are relatively large and stemmed. Consequently, the first few steps of our taxonomic key are equivalent to those of Thomas' key. After the first few steps, however, the two keys are quite different. The criteria used to distinguish the projectile point types in the Mojave Desert center on length of stem and widty of shoulders, criteria not included in Thomas' key. Therefore, our types are not comparable to Thomas' without applying our criteria to the types defined by Thomas (1981).

Lake Mojave and Silver Lake Types: The Lake Mojave Series

The Lake Mojave and Silver Lake types were first described by Amsden (1937:80-84) 50 years ago; the phrasing of that description appears archaic and ambiguous today. The attributes that Amsden cites as characteristic of the Lake Mojave type are:

1. long tapering stem;
2. slight (narrow) shoulders (if present);
3. generally diamond-shaped with longer stem than blade; and
4. varies in form between an oval form on one hand and the Silver Lake type of the other.

The Silver Lake type by contrast is said to exhibit:

1. greater definition of shoulder than the Lake Mojave type;
2. a shorter stem than the Lake Mojave type, never more than one-half the length and usually about one-third of the length; and
3. convex base.

Rogers (1939:35) placed both Lake Mojave and Silver Lake points in a single "Stemmed Blades" category. He states that this category is:

> Characterized by a long, broad stem with a rounded base. It was constructed from a leaf-shaped blade by reducing the width of the blade from the base end toward the tip for a distance of one-half to two-thirds the total length. This usually left pronounced shoulders at the junction of the stem and blade. The blade section is usually short, stubby and obtusely pointed. (Rogers 1939:35)

Rogers (1939:35) also notes that Amsden subdivided this category into Lake Mojave and Silver Lake types. Here the Lake Mojave and Silver Lake types are recognized as morphologically and technologically related series of forms herein called the Lake Mojave series.

These descriptions formed the basis for the traditional intuitive types even though Amsden's descriptions were based on only 12 Lake Mojave and 15 Silver Lake points (Amsden 1937:80,84) and Rogers' (1939:35) was based on a total of 25 specimens. The attributes given priority by Rogers and Amsden and apparently by later archaeologists were the Length of Blade

(LB), Length of Stem (LS), Proximal Shoulder Angle (PSA), Basal Width (WB), and Width of Shoulders (WS). The Width of Shoulder Measurement is calculated by subtracting the Neck Width (WN) from the Maximum Width at the Shoulders (MWSh).

These attributes are described here as linear measurements and degrees of angles. It is assumed that a "type" represents patterned behavior by the makers and that these measurements will reflect that behavior. As Thomas (1981:14-15) notes, however, there are changes that occur in these measurements after manufacture, due to wear, breakage and maintenance. These "use-life modifications" change the measurements and introduce variability that is not a result of the patterned behavior of point manufacture. Use-life modifications are often observed and described by archaeologists and at times exhibit patterns that may be attributed to use or function or techniques of resharpening rather than manufacture.

Rogers (1939:35) states that among his "Stemmed Blades" category "many...have blunted irregular tips as if they had been broken and resharpened." Tuohy (1969) describes the pattern of breakage and resharpening on similar points from the western Great Basin. There is ample evidence for breakage and resharpening of the blades with breakage often occurring just above or just below the shoulder (Tuohy 1969:138). The attributes of the blade are often missing and when present, are highly variable because of use-life modification. Consequently, we have limited the blade attributes' use in defining the types to only those relevant to the shape and size of the shoulders. This unfortunately eliminates one of the traditional means of distinguishing Lake Mojave from Silver Lake points, the length of stem relative to length of blade.

Pinto Point Series

In the original description of Pinto points, Amsden (1935:44) notes as major attributes the "definite although narrow shoulders and usually... incurving [concave] base", as well as the relatively great thickness. Rogers (1939:54) later subdivided Pinto points into four stemmed types and a leaf-shaped type. The four stemmed types were based on attributes of stem form.

In 1957, Harrington (1957:51-53) redefined the Pinto types so as to include five stemmed forms based primarily on shoulder attributes.

Harrington (1957:51) notes the resharpening of the blades of the Pinto points and its effect on the overall form; however, neither Rogers (1939) nor Amsden (1935) make similar observations. The major criteria for determining the Pinto types are attributes of the shoulders and stem. Most blade attributes are again omitted from the definition of the type. The basal concavity is recognized as a distinguishing attribute of the Pinto types by both Amsden (1935) and Harrington (1957), but Rogers' Type 2 Pinto exhibits a straight base in all examples he illustrates (1939:54-55). We follow Amsden and Harrington on this point because in recent years the indented base has become an element of the Pinto point definition (Thomas 1970, 1981).

Recently the definition of the Pinto point has been recognized as a problem for the archaeologist of the desert west (Warren 1980a, 1980b) and is in need of clarification. Such a clarification is not the primary goal of this paper. Here we describe points that traditional knowledge of Mojave Desert archaeology recognizes as Pinto points. The description of this type is based on linear and degrees of angle measurements that describe the shape of the stem and shoulders. The goal is a clear description arrived at by observations which can be duplicated by other archaeologists.

Definition of Attributes

The attributes listed here, illustrated in Figure 4-1. include some borrowed directly from Thomas (1981) and others that have been shown to be important in distinguishing points of the Lake Mojave and Pinto series in the Mojave Desert. These are as follows:

Distal Shoulder Angle-DSA. The Distal Shoulder Angle is that angle formed between line (A) defined by the shoulder at the distal point of juncture and line (B) drawn perpendicular to the longitudinal axis (C) at the intersection of A and C. DSA ranges between 90 and 270 degrees.

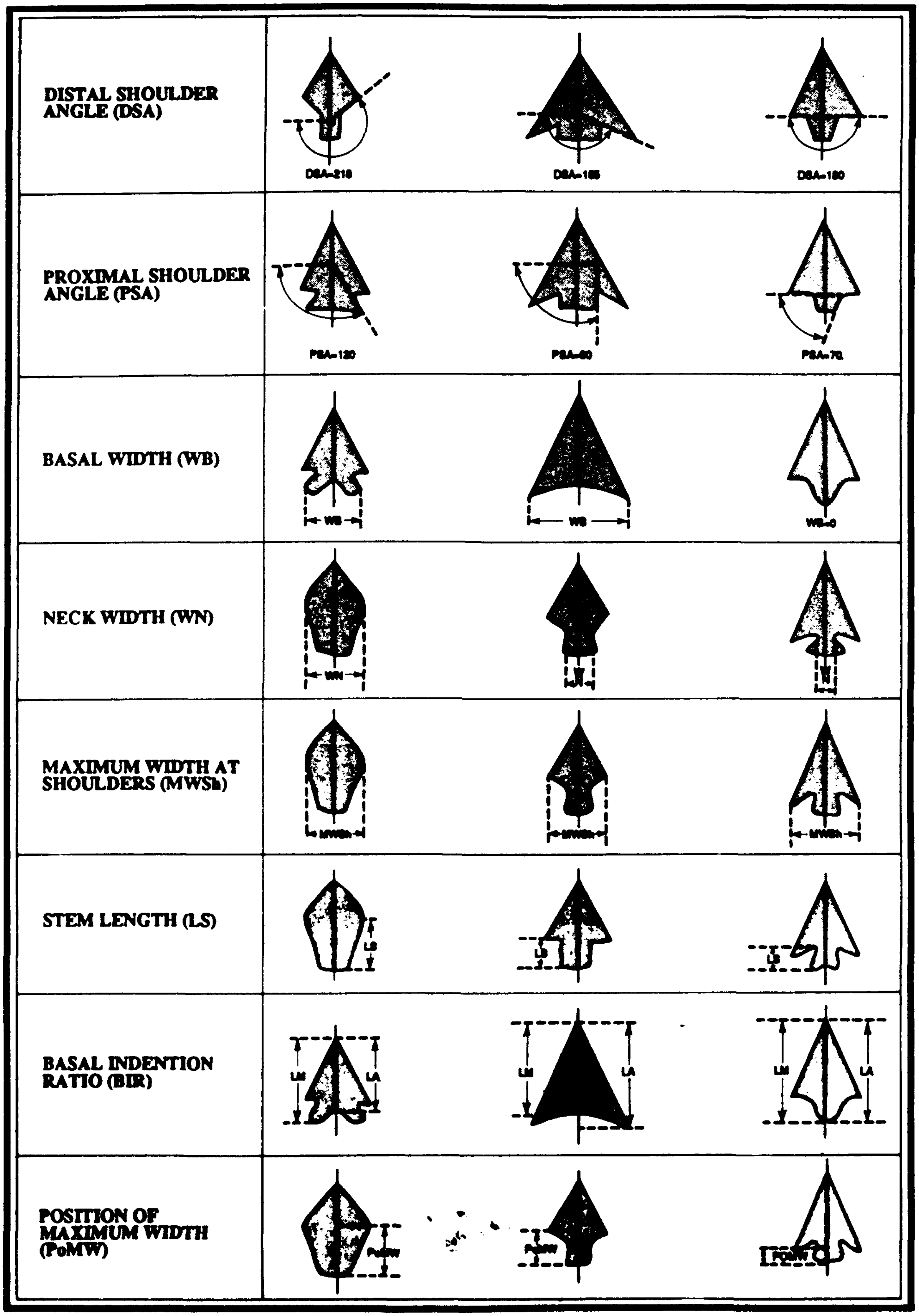


FIGURE 4-1. PROJECTILE POINT ATRIBUTES

If points are asymmetrical, the smaller value of DSA is measured. DSA is recorded to nearest 5 degrees. (Thomas 1981:11).

Proximal Shoulder Angle-PSA. The Proximal Shoulder Angle is that angle formed between the line (D) defined by the proximal point of juncture and line (B) plotted perpendicular to the longitudinal axis at the intersection of C and D. PSA ranges between zero degrees and 270 degrees. If points are asymmetrical, the larger value of PSA is measured. (Thomas measures the smaller value. However, by measuring the smaller value the possibility of recording use-life modification is increased.) PSA is recorded to the nearest five degrees. (Thomas 1981:11).

Basal Indention Ratio-BIR. The length measured along the longitudinal axis (C) divided by the maximum length measured parallel to the longitudinal axis (C). The Basal Indention Ratio ranges between .0 and about .90 (Thomas 1981: 11).

Basal Width-WB. The width of the widest portion of the base (Thomas 1981:13).

Neck Width-WN. The width of the stem at the intersection of the stem and shoulders.

Maximum Width at Shoulder-MWSh. Width of blade at intersection of blade edge and shoulder.

Shoulder Width-WSh. Sum of the width of the two shoulders. Calculated by subtracting neck width from maximum width at shoulder (WSh=MWSh-WN).

Shoulder Width-Maximum Width at Shoulder Ratio-WSh/MWSh. The Shoulder Width-Maximum Width at Shoulder Ratio is the ratio of the Shoulder Width to the Maximum Width at the Shoulder. Shoulder Width-Maximum Width at Shoulder Ratio=WSh/MWSh.

Stem Length-LS. Stem length is the length of the stem from base to intersection with shoulder, measured parallel to Longitudinal Axis. If shoulders are asymmetrical the smaller value is measured.

One additional term needs to be defined before this key can be used in a consistent manner. That term "shoulder" is not defined by Thomas (1970, 1981) although the primary division in his key is based on the presence or absence of this attribute. In most cases the presence or absence of a shoulder would be agreed upon by most archaeologists. However, as the shoulder becomes less pronounced and as the DSA and PSA approach a difference of 180 degrees, agreement as to the presence or absence of the shoulder will certainly decrease. Lake Mojave points often exhibit very slight or no shoulders with the difference between the DSA and PSA approaching or equalling 180 degrees. There is also a clear continuum from these "lanceolate" points to the clearly shouldered points within what has been traditionally called the Lake Mojave point type. The term "shoulder" clearly is in need of a definition which can be objectively identified. The terms "shoulder" and "stem" refer to the proximal end of the projectile point, from the point where the width is reduced to facilitate hafting to the base. The angle formed by the shoulder and stem equals the angle of the notch opening (Thomas 1981:14). As the notch opening increases the differentiation between the shoulder and the stem decreases. When the notch opening reaches 180 degrees the shoulder and the stem are no longer differentiated and the point becomes "lanceolate" or "diamond" shaped, and is often described as lacking a stem. However, the taxonomy used here defines the widest point on lanceolate and diamond shaped forms as the shoulder with the stem defined by measurable Proximal Shoulder Angle and Distal Shoulder Angle. If the edge below the shoulder is convex so the distal shoulder angle and proximal shoulder angles cannot be measured, or if the difference between the PSA and DSA is greater than 180 degrees then the projectile point is classed as shoulderless, and nonstemmed.

It should also be noted that lanceolate and diamond shaped shouldered points can be segregated from the "traditionally" shouldered and stemmed forms by the shoulder width (Maximum Width at Shoulder [MWSh] minus Neck Width [WN]). All lanceolate and diamond shaped will have a shoulder width of zero ($WSh=0$) whereas all points with notch openings less than 180 degrees will have shoulder width greater than zero ($WSh>0$).

The Taxonomy: Key I for Early Times Projectile Points

The taxonomic system utilized here is borrowed directly from Thomas (1981); the initial steps are identical to those described in his Monitor Valley Projectile Point Key (Thomas 1981:25). Because the unstemmed, side-notched and small stemmed points are so few in number, that portion of the key has not been reproduced here. The following represents the additional steps added to the Monitor Valley Projectile Point Key in order to incorporate the Pinto, Lake Mojave, and Silver Lake points from the Mojave Desert. The range and mean measurements of projectile points by type are presented in Table 4-1.

1.	Point is unshouldered	out of key
1a.	Point is shouldered	(2)
2.	Point is side-notched	out of key
2a.	Point is stemmed	(3)
3.	Point is small. Neck width < 10.00mm	out of key
3a.	Point has neck width = or > 10.00mm	(4)
4.	Point has basal width = or > 10.00mm	(5)
4a.	Point has basal width < 10.00mm	(13)
5.	Point has BIR < .98	(6)
5a.	Point has BIR = or > .98	(16)
6.	Point has WSh/MWSh ratio = or < .15	PINTO SHOULDERLESS
6a.	Point has WSh/MWSh ratio > .15	(7)
7.	Point has PSA = or < 105	(8)
7a.	Point has PSA > 105	(11)
8.	Point has PSA = or > 80	(9)
8a.	Point has PSA < 80	out of key
9.	Point has DSA = or > 80	(10)
9a.	Point has DSA < 80	out of key
10.	Point has DSA = or > 220	PINTO SLOPING SHOULDER WITH STRAIGHT STEM

10a.	Point has DSA < 220	PINTO SQUARE SHOULDER WITH STRAIGHT STEM
11.	Point has Basal Width = or > MWSh	out of key
11a.	Point has Basal Width < MWSh	(12)
12.	Point has DSA = or > 220	PINTO SLOPING SHOULDER WITH EXPANDING STEM
12a.	Point has DSA < 220	PINTO SQUARE SHOULDER WITH EXPANDING STEM
13.	Point has LS/MWSh ratio < .68	(14)
13a.	Point has LS/MWSh ratio = or > .68	(15)
14.	Point has LS/MWSh ratio = or < .45	out of key
14a.	Point has LS/MWSh ratio > .45	LAKE MOJAVE SHORT-STEM (FORMERLY SILVER LAKE)
15.	Point has PSA > 85	LAKE MOJAVE SHORT-STEM (FORMERLY SILVER LAKE)
15a.	Point has PSA = or < 85	LAKE MOJAVE LONG-STEM (FORMERLY LAKE MOJAVE)
16.	Point has 8.5mm = or > ShW = or > 2.0mm	(17)
16a.	other	out of key
17.	Point has LS/MWSh ratio = or > .25	SILVER LAKE RECTANGULAR-STEM (FORMERLY SILVER LAKE)
17a.	Point has LS/MWSh ratio < .25	out of key

The Lake Mojave Series

The projectile points of the Lake Mojave series (Plate 4-1) would traditionally be classed as Lake Mojave and Silver Lake points. The variability within these traditional "types," especially the Silver Lake "type," is considerable. Consequently, the Lake Mojave series, as defined on the bases of 50 specimens, consists of three variants: (1) Lake Mojave Long-stem; (2) Lake Mojave Short-stem (formerly Silver Lake); and (3) Silver Lake Rectangular-stem (formerly Silver Lake). These three variants appear to represent the morphological range within which the projectile points traditionally classed as Lake Mojave and Silver Lake can be placed. All exhibit relatively

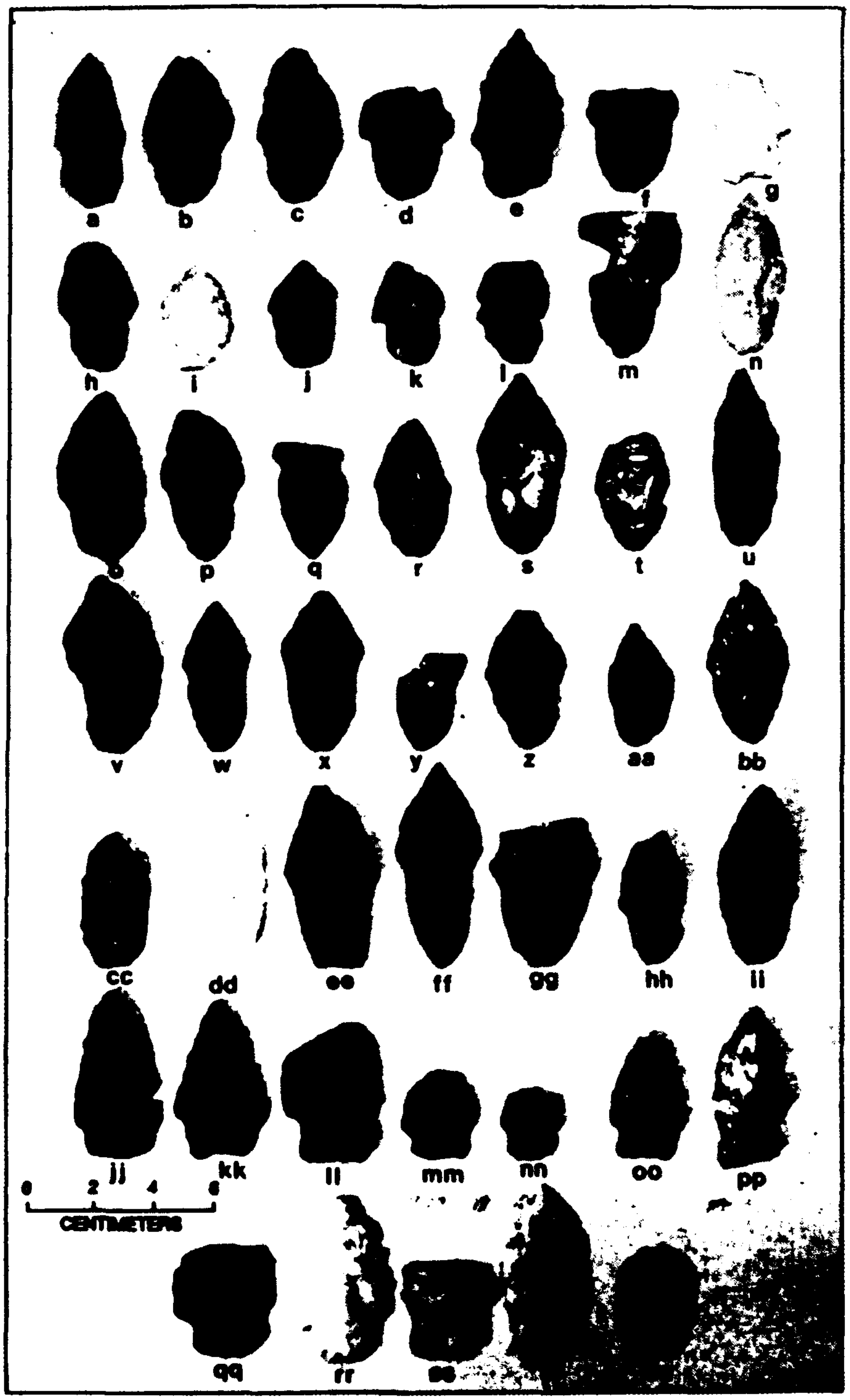


PLATE 4-1. LAKE MOJAVE AND SILVER LAKE SERIES PROJECTILE POINTS. a-n: Lake Mojave Short Stem; n-ii: Lake Mojave Long Stem; jj-uu: Silver Lake Rectangular Stem

broad stems, as reflected in the neck width measurement, and are generally large enough to be considered to have been dart or spear points. Each of the variants is described below.

1a. Lake Mojave Long-stem (21 specimens) - Plate 4-1, o - ii (Rows 3,4,5,)
Lanceolate or stemmed with long contracting stems and convex bases. Lanceolate forms lack shoulders and shoulder widths on other forms vary considerably. On complete specimens the stem is usually equal to or longer than the blade. The distinguishing characteristics of the Lake Mojave Long-stem variant are: (a) Basal Width (WB) = or < 10.00mm; (b) LS/MWSh = or > .68; and (c) PSA = or < 85. Six (29%) specimens are chalcedony and 15 (71%) are metavolcanic.

Table 4-1: Projectile Point Measurements by Type.

Type	Length			Width			Thickness		
	Range	Mean	N	Range	Mean	N	Range	Mean	N
1.A	3.21-6.51	5.00	17	2.02-3.44	2.56	20	0.52-1.19	0.69	22
1.B	3.26-5.14	4.37	8	2.14-2.95	2.56	13	0.62-1.04	0.76	14
1.C	-	-	-	-	-	-	0.76	-	1
2.0	2.21-5.60	4.3	11	1.94-3.18	2.65	14	0.53-1.14	0.72	14
3.A	4.87	-	1	2.20-3.87	3.22	4	0.69-0.87	0.77	4
3.B	3.79-3.93	3.86	2	2.22-3.00	2.61	2	0.63-0.71	0.66	3
3.C	6.1	-	1	2.69	-	1	0.90	-	1
3.D	2.62-5.81	4.13	7	2.11-3.23	2.31	9	0.52-0.96	0.69	9
3.E	-	-	-	1.90-2.82	2.33	5	0.46-0.81	0.69	5
4.0	-	-	-	3.20-3.74	3.47	2	0.63-0.74	0.69	2
5.0	4.19-6.00	5.00	3	2.50-2.99	2.70	3	0.62-1.45	0.97	3
6.0	3.16-4.05	3.54	3	2.01-2.13	2.07	3	0.70-0.81	0.75	3
7.0	-	-	-	2.36	-	1	0.57	-	1
8.0	3.94	-	1	2.15	-	1	0.97	-	1
9.0	4.52	-	1	3.17-4.19	2.45	2	0.73-0.78	0.76	2
10.0	3.27-3.36	3.3	2	1.91-2.53	2.22	2	0.68-0.69	0.69	2
11.0	3.96	-	1	2.23	-	1	0.30	-	1
12.0	3.00-4.64	3.82	2	2.91-3.17	3.04	2	0.42-0.70	0.56	2
13.0	-	-	-	2.27	-	1	0.55	-	1
14.0	3.06-3.60	3.33	2	2.22-2.87	2.50	4	0.73-0.80	0.78	4
15.0	4.67-5.76	5.20	2	2.32-3.05	2.69	2	0.73-0.85	0.79	2
16.0	-	-	-	2.57-3.12	2.74	6	0.59-0.83	0.71	6

1b. Lake Mojave Short-stem (15 specimens) - Plate 4-1, a-n (Rows 1&2)

Shouldered with slightly expanding to contracting stems and convex bases. The stem length (LS) is shorter relative to the maximum width at the shoulders (MWSh) than on the Lake Mojave Long-stem variant. The distinguishing characteristics for the Lake Mojave Short-stem are: (a) WB = or < 10.00mm; and (b1) .45 = or < LS/MWSh < .68; or (b2) LS/MWSh > .68 and PSA > 85. The short stem variant is distinguished by a shorter stem relative to the maximum width of the shoulders and/or a parallel or slightly expanding stem. One (7%) is obsidian, three (20%) are chalcedony, and 11 (73%) are metavolcanic.

1c. Fragmentary Lake Mojave series points (4 specimens) -Not Illustrated

Two specimens are center sections with broken blades and stems and two have complete blades but exhibit broken stems. All four exhibit the slight shoulders and contracting stems that are characteristic of the Lake Mojave series points. Three are basalt and one is an orange chalcedony.

2. Silver Lake Rectangular-stem (14 specimens) - Plate 4-1, jj-uu

Shouldered with straight to slightly expanding stems with straight bases. Shoulders are essentially straight but may be slightly barbed (DSA<90) or slightly sloping (DSA>90). The distinguishing characteristics are: (a) WB= or > 10.00mm; (b) BIR > .98; (c) 2mm = or < ShW = or < 8.5mm; and (d) LS/MWSh= or > .25.

Pinto Series

"Pinto point" is probably the most misused designation in Great Basin and California desert archaeology. The problems surrounding this "point-type" have been discussed elsewhere (Warren 1980a, 1980b) and will not be repeated here, nor will we attempt to resolve these problems. The taxonomy presented here is an attempt to describe a series of typological and technologically similar points that appear to be within the range of variation defined by Amsden (1935), Rogers (1939), and Harrington (1957) as Pinto points, and to distinguish these morphological forms from other "types" found in the central Mojave.

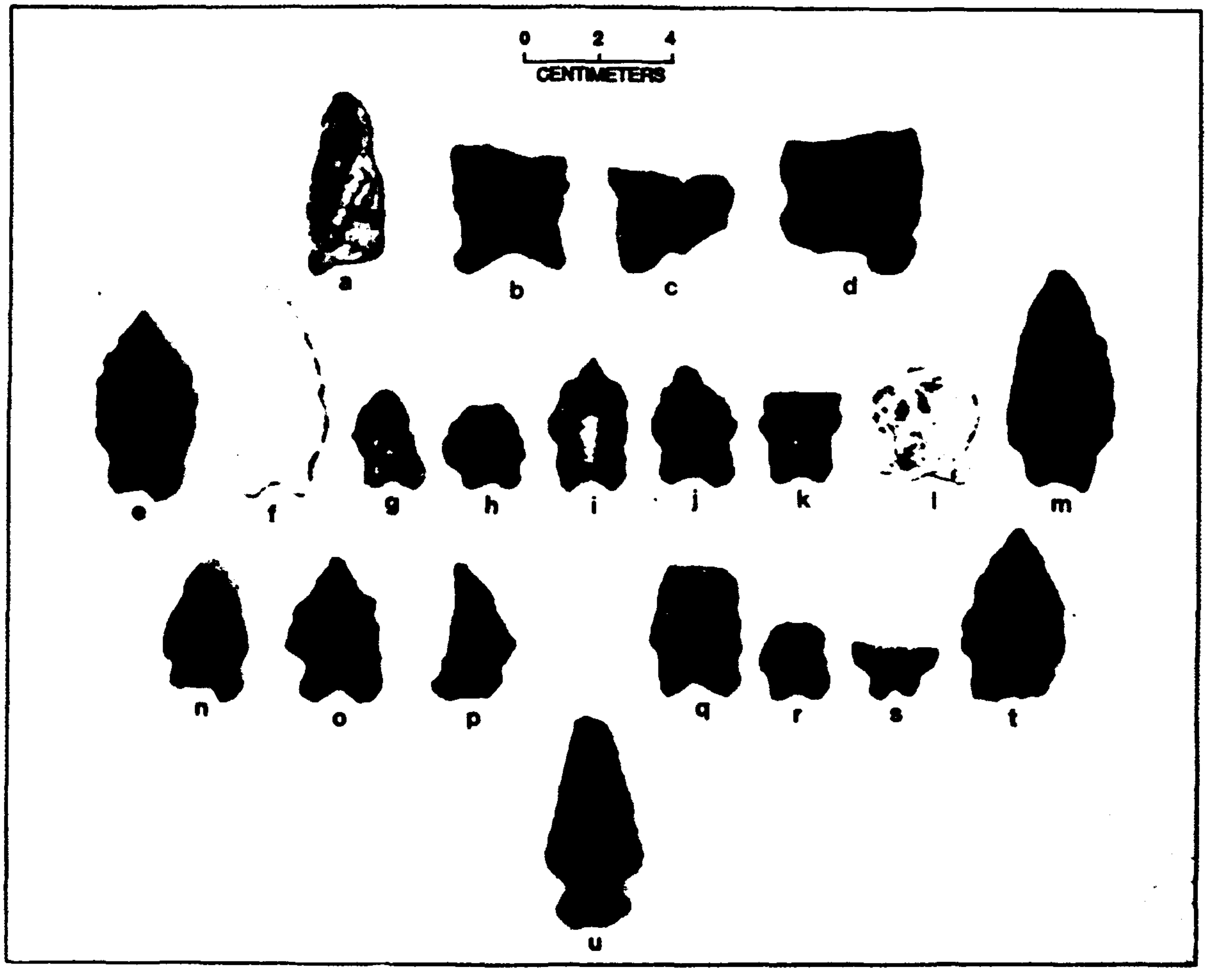


PLATE 4-2. PINTO SERIES PROJECTILE POINTS. a-d: Pinto Shoulderless; e-m: Pinto Sloping Shoulder Straight Stem; n-p: Pinto Sloping Shoulder Expanding Stem; q-t: Pinto Square Shouldered Straight Stem; u: Pinto Square Shouldered Expanding Stem

At this time five variants are recognized in the Pinto Series. These variants are: (1) Pinto Shoulderless; (2) Pinto Sloping-shoulder Expanding-stem; (3) Pinto Square-shoulder Expanding-stem; (4) Pinto Sloping-shoulder Straight-stem; and (5) Pinto Square-shoulder Straight-stem. All Pinto points exhibit relatively broad stems (WN > 10mm and WB > 10mm) with concave or indented bases (BIR < .98). The variants within the series are determined by attributes of stems and shoulders.

3a. Pinto Shoulderless (4 specimens) - Plate 4-2, a-d

Although termed shoulderless, specimens of this variant exhibit a slight constriction above the base, producing a slight shouldering effect, and a broad stem that expands so that the basal width (WB) is approximately the same as the width at the shoulders (MWSh). The single attribute that distinguishes this variant from others in the Pinto series is the smaller ShW/MWSh ratio (ShW/MWSh = or < .15).

3b. Pinto Sloping-shoulder Expanding-stem (3 specimens Plate 4-2, n-p) and

3c. Pinto Square-shoulder Expanding-stem (1 specimen - Plate 4-2, u)

These two variants both exhibit expanding stems and are differentiated from the straight stem variants by a large proximal shoulder angle (PSA > 105). They are further differentiated from large side-notched points by basal widths smaller than the maximum width at shoulder (WB < MWSh). The Sloping-shoulder and Square-shoulder Expanding-stem variants are distinguished from one another by the distal shoulder angle. The Sloping-shoulder variant has a DSA = or > 220; The Square-shoulder variant has 180 < DSA < 220.

3d. Pinto Sloping-shoulder Straight-stem (9 specimens - Plate 4-2, e-m) and

3e. Pinto Square-shoulder Straight-stem (5 specimens - Plate 4-2, q-t)

These two variants share straight stems that are identified by proximal shoulder angles between 80 and 105 degrees (80 = or < PSA < or = 105) and are distinguished from one another by the distal shoulder angles: the Sloping-shoulder variant has a distal shoulder angle equal to or

greater than 220 degrees (DSA = or > 220) and the Square-shoulder variant exhibits a distal shoulder angle between 180 and 220 degrees (180 < DSA < 220).

Miscellaneous Projectile Points

4. Fluted Points (2 specimens - Plate 4-3, a-b)
Fluted points are represented by basal fragments of two broad lanceolate points with concave bases and straight edges that contract slightly toward the base. Specimen 178-2261 is made of "white and tan" chalcedony and exhibits what appears to be a thick weathering rind that is visible on all edges including the transverse break. The fluting of specimen 178-2261 consists of a series of two thinning flakes on each face that extend from the base onto the face for distances of 16.0 mm and 17.4 mm, and end in shallow step fractures.

The second specimen, 178-6335, recovered from Component 1 of the Henwood Site, is black and white moss agate. The fluting on this specimen consists of two flakes on one face, 20.5 and 22.0 mm long, terminating in shallow step fractures. One flake is removed from the second side and is more than 22.9 mm long. The termination of this flute has been removed by a flake originating at the transverse fracture. One basal edge of 178-6335 has been removed by a burinated flake 21.0 mm long, originating at the basal corner. This flake scar exhibits rounded edges which suggests that it had occurred prior to the transverse break which exhibits sharp edges. The extant basal edges are rounded and may have been slightly ground, but not to the degree that is characteristic of Clovis points.

5. Contracting stem points (3 specimens - Plate 4-4, c-e)
One of these points (440-137) made of basalt, is a Gypsum point with well developed shoulders (one is broken and retouched) and a contracting stem with a convex base. The other two diverge considerably from the traditional definition of the Gypsum point (Harrington 1933). A white chalcedony specimen (174-462) exhibits a base that constricts from the shoulder to a blunt pointed base. The third point (178-8), a large, basalt specimen, exhibits straight shoulders and a contracting stem with a straight base. One corner of the stem has been broken and retouched.

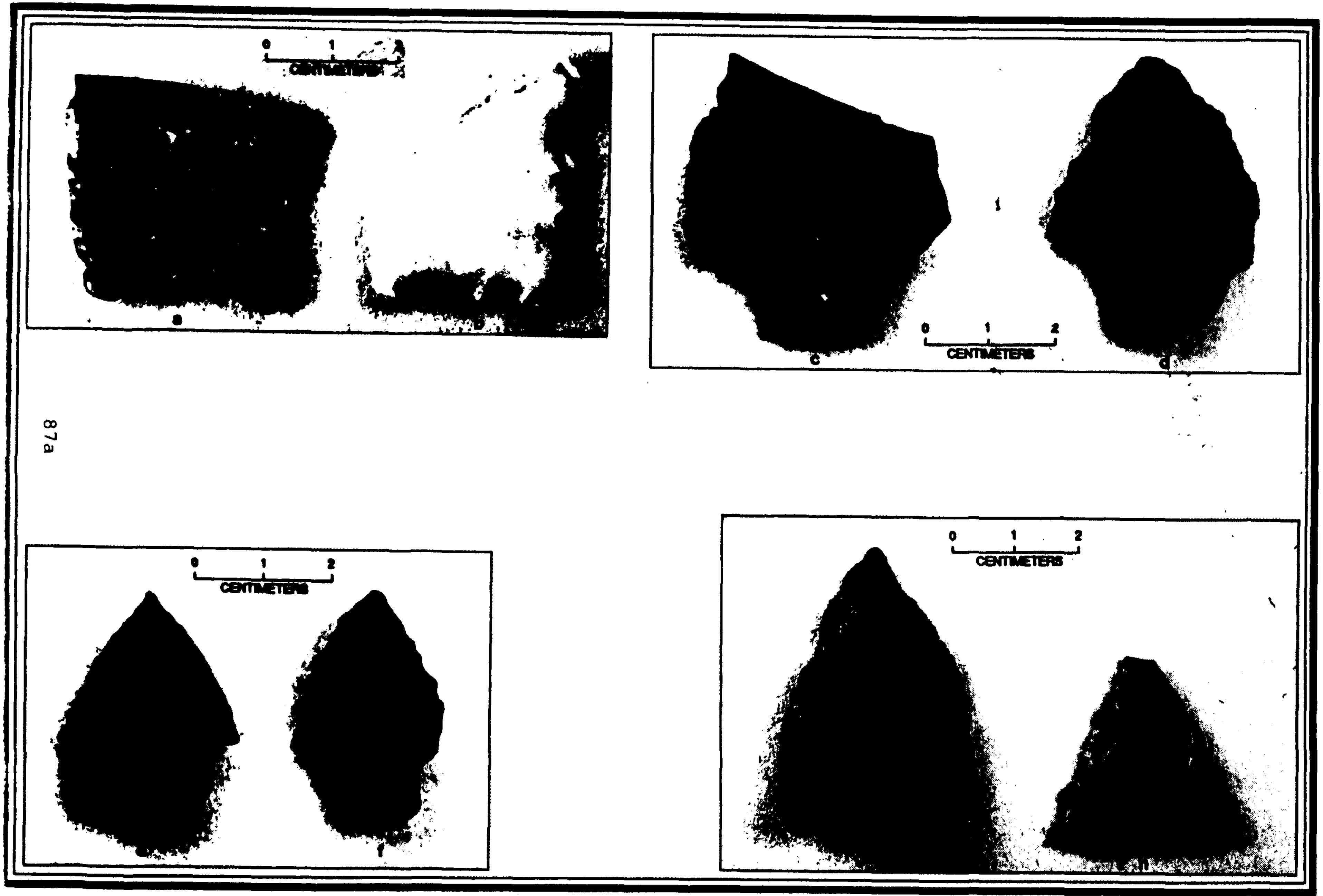


PLATE 4-3. MISCELLANEOUS PROJECTILE POINTS. a,b: Fluted Points; c,d: Large Stemmed Points; e,f: Small Stemmed Points; g,h: Large Triangular Points

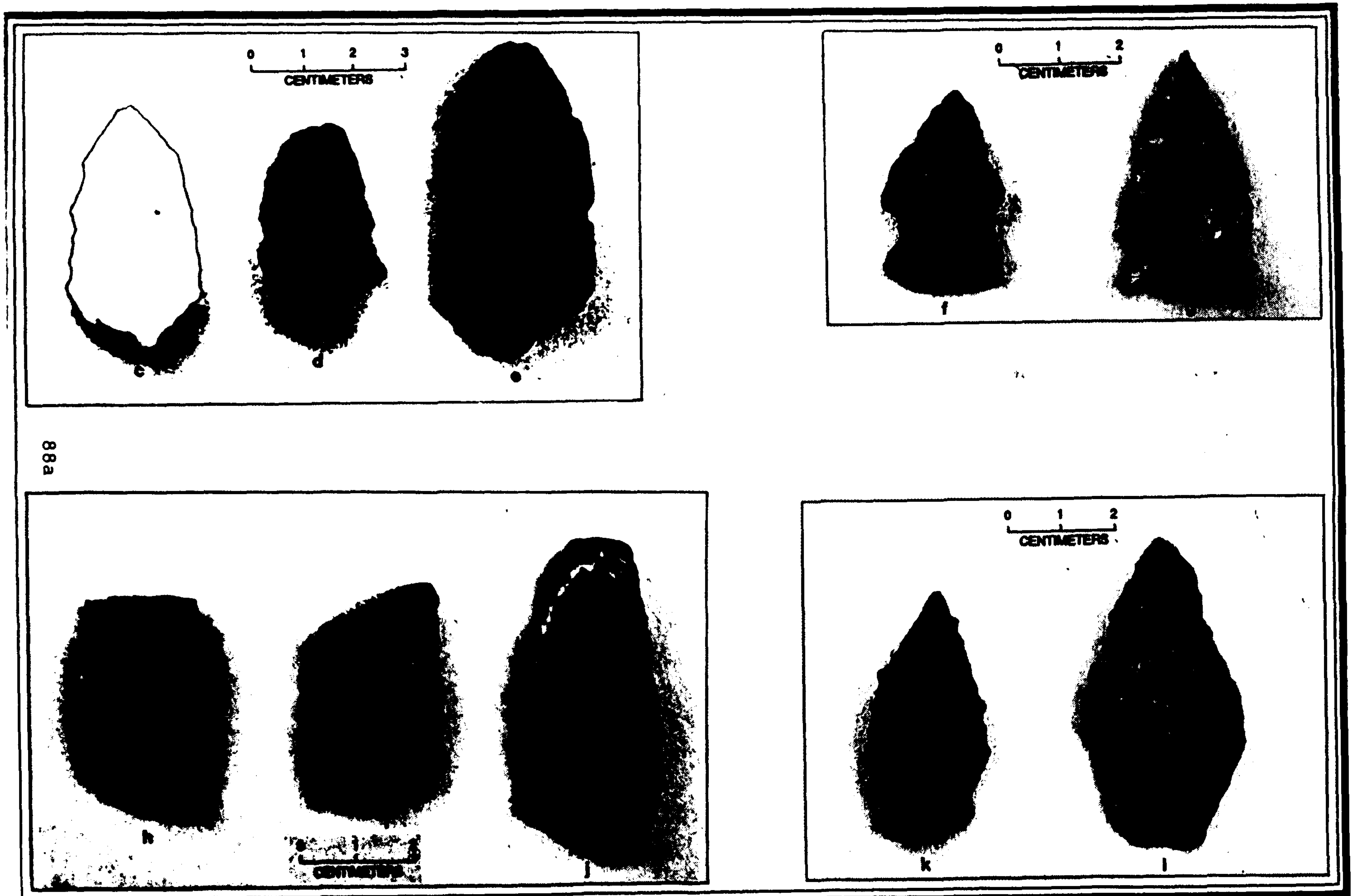
Specimen 178-8 is shaped by percussion and edged by uniface and biface retouch, including the rounded tip. The morphology of this point suggests that it may have functioned as a cutting tool rather than a projectile point.

6. Large Side-notched points (3 specimens - Plate 4-4, f-g)
Each of these three points is probably morphologically distinct. Specimen 178-2154 (not illustrated) is obsidian and exhibits a concave base, small shoulder height above narrow notches, and concave edges. The blade has a thick biconvex cross section with edge angles too steep to have functioned as a cutting tool. Specimen 178-4255 is a gray chert or chalcedony, and exhibits a straight base, small shoulder height above narrow notches and slightly convex edges. Cross section is lenticular and edges are irregularly serrated. Specimen 178-793 is basalt, exhibits a convex base, broad notches above an expanding stem and a greater shoulder height than the other two. Blade edges are straight and slightly convex and cross section is lenticular.

7. Elko Eared point (1 specimen - Plate 4-5, a)
A fragmentary basal portion made of tan chalcedony exhibits the characteristic concave base with broad based stem, deep notches and straight shoulders. Blade edges appear to be slightly convex.

8. Single shoulder point (1 specimen - Plate 4-5, b)
This specimen is tan chert, exhibits a rectangular stem and a single sloping shoulder with an adjacent straight edge. The opposite edge is slightly convex from base of stem to tip of blade. The point has thick biconvex cross section. The unshouldered edge may have been reworked after the shoulder was broken.

9. Large stemmed points (2 specimens - Plate 4-3, c-d)
Specimen 178-576 is a large basalt point with a flat lenticular cross section, a rectangular stem, and slightly barbed shoulders (one shoulder is broken). Specimen 174-412 is also basalt but smaller with contracting stem and straight shoulders. Both specimens are produced by percussion flaking and unifacial edging by pressure along blade edges and stem.



'LATE 4-4. MISCELLANEOUS PROJECTILE POINTS. c-e: Gypsum Points; f,g: Large Side Notched Points; h-j: Lanceolate or Elongate Triangular Points; k,l: Straight Based Diamond Shaped

10. Small stemmed points (2 specimens - Plate 4-3, e-f)

Specimen 178-645 is a short, broad basalt point with a broad stem and narrow, straight shoulders. The blade edges are convex and the stem tapers to a broken base. It is relatively thick and lenticular in cross section. It is finished by bifacial pressure flaking on both blade edges. Specimen 176-15 is a small basalt point with a relatively narrow stem, sloping shoulders, and convex edged blade. The stem is straight with a convex base. It is lenticular in cross section and finished by irregular pressure or light percussion flaking.

11. Stemmed Flake point (?) (1 specimen - Plate 4-5, c)

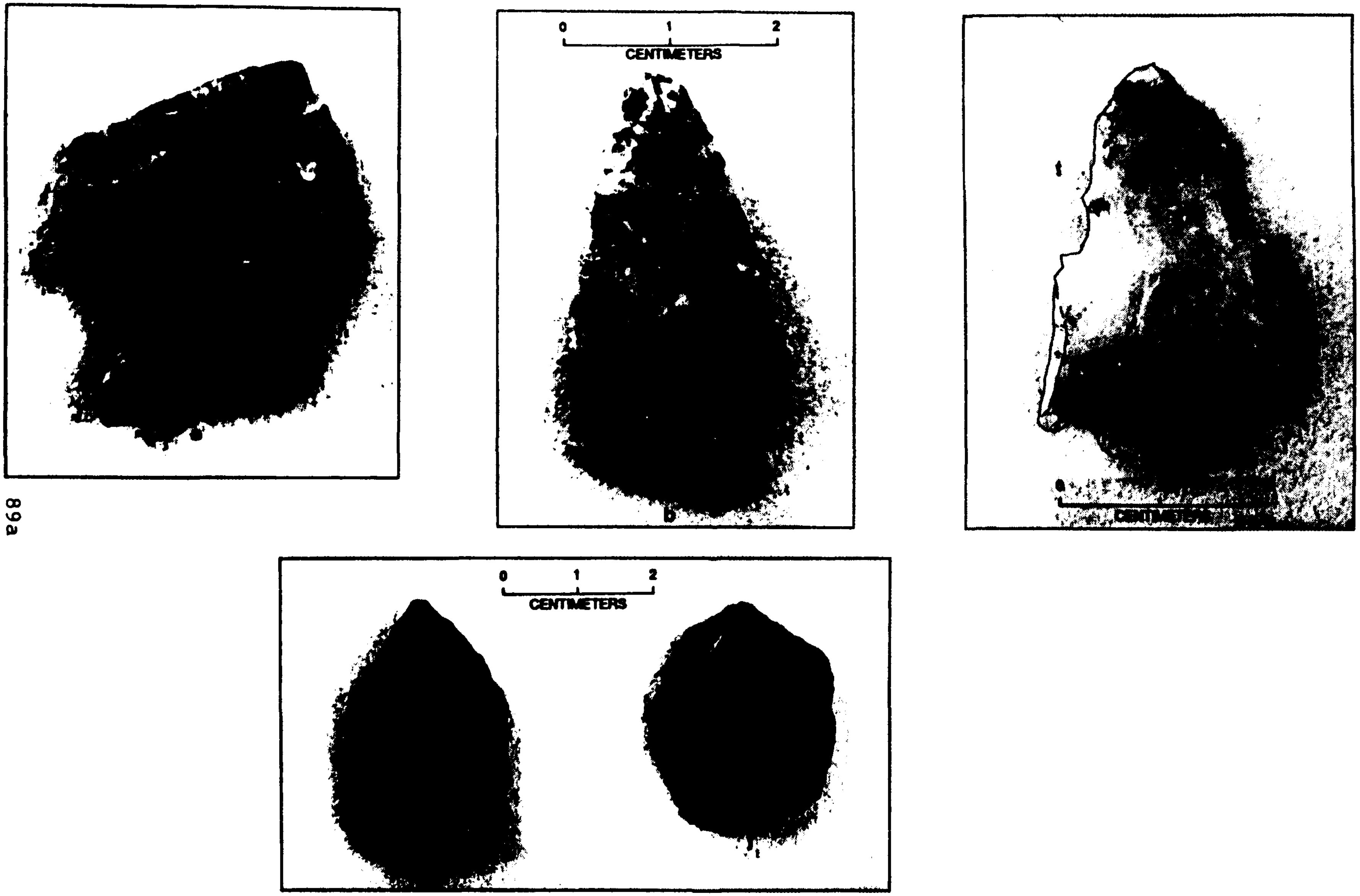
Complete specimen made on a translucent white and red chalcedony flake by pressure retouch limited to the edges. The resulting form is a straight stemmed point with straight base and slightly barbed shoulders. The edges of the blade are generally convex, but exhibit very irregular patterns of flaking. Retouch tends to be unifacial at any one point along the edges; flakes are moved from both faces but not generally at the same location along the edge. The notches forming the stem and shoulders were produced by bifacial pressure flaking. This specimen may well have functioned as something other than a projectile point.

12. Large triangular points (2 specimens - Plate 4-3, g-h)

Specimen 178-4326 is brown chert, triangular in outline with straight edges and lenticular cross section. It has been finished by pressure flaking. Specimen 178-3109 is large, basalt, and exhibits a concave base and convex edges. It is lenticular to plano-convex in cross section and exhibits unifacial edging at the base.

13. Lanceolate or elongate triangular points (3 specimens - Plate 4-4, h-j)

Specimen 178-7857 is a jasper lanceolate form with a concave base, convex edges and thin lenticular cross section. This specimen is very similar to specimens reported from Lake Mojave and referred to as the "Yuma" type (Amsden 1937:85-88) and differs from the remaining two specimens. Specimens 178-24 and 278-1810 are basalt with convex bases and thick lenticular cross sections. Specimen 178-24 exhibits convex edges, whereas specimen 178-1810 has straight edges.



.ATE 4-5. MISCELLANEOUS PROJECTILE POINTS. a: Elko Earred Points; b: Single Shoulder Point; c: Stemmed Flake Point; i,j: Squat Lanceolate Points

14. Squat lanceolate points (2 specimens - Plate 4-5, i-j)

These two basalt specimens appear to be reworked bases of broken points. They are both basalt, exhibit nearly parallel, but slightly convex edges with a relatively sharp break in the outline to form short points. The base of 174-458 is slightly convex and the base of 178-4236 is broken but appears to have been similar to that of 174-458. They are both lenticular in cross section. Specimen 178-458 is finished by percussion flaking, but 178-4236 exhibits pressure flaking along the tip.

15. Straight-based diamond-shaped point (2 specimens - Plate 4-4, k-l)

Specimen 180-264 is a felsite or green-gray chert, exhibits straight blade edges and straight edges that taper from point of maximum width to straight base. It is bifacially flaked, but exhibits a nearly plano-convex cross section. Specimen 178-532 is more nearly leaf-shaped with a straight but slightly angled base from which the edges expand to the point of greatest width. From the point of greatest width to the tip the edges are convex and irregularly serrated. This specimen is basalt, exhibits a thick lenticular cross section and has been finished by pressure retouch to produce the serrations along the edges.

16. Center sections and fragments of square-shouldered points (6 specimens)

These are fragments missing both bases and tips but exhibiting straight shoulders and wide stems. All exhibit percussion flaking, while pressure retouch occurs on only three of the six specimens. Five (83%) are basalt and one (17%) is rhyolite.

17. Parallel-edged, round-based stem or base fragments (5 specimens)

These five fragmentary specimens all exhibit straight, nearly parallel edges and convex bases. Specimens 440-401, 178-5, 178-3796 and 178-2982 could be stems of either long stem or short stem variants of the Lake Mojave points, but 440-311 is probably the base of a large leaf-shaped point or knife. All are made of basalt.

18. Basal(?) fragments with contracting edges and convex or pointed bases (12 specimens)
This class of fragmentary specimens exhibits contracting edges and rounded or flat bases, suggesting that they are stems of the long stem variant of the Lake Mojave points (e.g. 178-660, 174-6, 178-5485) or bases of elongate leaf-shaped points or bifaces. Specimen 178-4229 is tan chalcedony and 178-7387 is a pinkish rhyolite. All others are basalt.

19. Tips, mid-sections and miscellaneous fragments (47 specimens)
These constitute a class of non-diagnostic fragments of relatively small and well worked bifaces that are believed to be projectile points. Sixteen (34%) are chalcedony, 30 (64%) are metavolcanics and one (2%) is obsidian.

BIFACES by Elizabeth Skinner

Introduction

Bifaces other than projectile points pose a particular problem for analysis because, unlike projectile points, they are not sorted into morphological or temporal types other than by vague ideas of what "Gypsum Knives" or "Pinto Knives" should look like. Traditionally these bifaces have not been typed to a morphological or functional category other than to the general category of "knives," based on size and outline, which intentionally or unintentionally implies function. In some cases bifaces have been grouped into technological types based on the perceived continuum of production, but these groupings depend on prior knowledge of the appearance of each stage and an inference regarding the intent of the flintknapper about the final product. According to Thomas and Bierwirth (1983:212), "realistic" analysis of the stages of manufacture is exceedingly difficult in the case of habitation sites, because the inference of "intent" is clouded. Site 4-SBr-4966 is primarily a habitation site representing at least late Lake Mojave to early Pinto occupation. Literally thousands of bifaces, complete and incomplete, were recovered from the surface of the site. The determination of assemblage composition and variability requires that finished and utilized bifaces be distinguished from progressive stages of manufacture. If this is not done the variability seen in the bifaces will be due to stage of manufacture as well as function or morphology. Ideally, once the finished and unfinished tools have been separated, the finished tools can be typed in such a manner as to represent functional and morphological types that exhibit change through time and variability through space.

Assigning the term "finished tools" to bifaces poses a different kind of problem. Technically a tool is finished when it is taken out of the sequence of manufacture and used, regardless of its "stage." A biface does not have to go through all five stages of manufacture before it can be used. "It is entirely conceivable that a rejected roughout or fine percussion blank could have been used for numerous functions, even though it is not a 'finished artifact' in a technological sense" (Thomas and Bierworth 1983:214).

A classification scheme was outlined for the biface analysis that should circumvent some of the problems discussed above. Independent classification schemes were constructed for morphological analysis, technological analysis and functional analysis. The first classification involved a morphological analysis of the 388 complete bifaces. Various nominal observations were taken on each biface. These included color, the condition (which parts of the biface were present and which absent), biface shape, base shape, basal corner form and cross section. Measurements were taken that included actual length and width, reconstructed length and width, maximum thickness, position of maximum thickness, corner height and measures to determine outline form. The raw data was entered into a Database II file and various descriptive statistics computed. Mean and standard deviation were calculated as well as a normalized position of maximum thickness (position of maximum thickness x 100/reconstructed length). Measures of symmetry/asymmetry and skewedness were also calculated.

An SAS hierarchical clustering program was executed using the following attributes: reconstructed length, width, and maximum thickness, mean skewedness, and symmetry/asymmetry. These attributes were chosen as those most likely to exhibit variation. The bifaces within the groups derived from this program are similar in outline but show a great deal of variability in size (length, width and thickness). Because the technological and functional analysis is not likely to keep the different sizes together in a group, another set of variables was used. For a morphological classification it seems, intuitively, that the meaningful variables are length, width, maximum thickness, and skewedness. A second SAS cluster program was run, whose resulting groups appear "good" on an intuitive level. Twenty clusters were used arbitrarily as the cut-off point because this seemed a reasonable number considering we have only 388 complete bifaces. As mentioned above, it is stressed that with bifaces we have no preconceived notion of how biface types should look as we do with projectile points. This allows for more objectivity but it also precludes having a good idea of what clusters are most meaningful and when to stop trying different combinations of attributes and say "these are our types." Unfortunately, due to constraints on time and money, we cannot continue trying different combinations of attributes. Thus, the second classification discussed above is used, and the broken bifaces are sorted into these types. These types are described below.

The number of clusters chosen to represent types was arbitrarily set at 20. When the complete bifaces were laid out as ordered by the computer, it became apparent that many of the types made more sense intuitively if they were subdivided at a level with a greater number of clusters, generally between 21 and 35 clusters but in one case at 50 clusters. Some of the bifaces were not placed into any clusters by the SAS program; these were typed by visual similarity to types established by the computer. Other bifaces were incomplete and lacked one or more of the attributes measured for analysis. These were also typed visually by comparison with the types established by the computer. Many of these latter bifaces could not be placed into any of the types defined by the clusters and were coded "untypeable." The complete biface types (those measured on the computerized file) and the incomplete bifaces are described below. Width and thickness measurements of fragmentary specimens and visual comparison with complete specimens made it possible to classify complete and biface base fragments in one taxonomy. In many cases, it appeared that these basal fragments would have gotten wider or thicker further from the base and these probable increases in width and thicknesses are noted. A large number of biface bases do not fit into the previously defined categories for complete bifaces, either because they were too large, too thin, or both. New categories were created for these specimens and they were integrated into the taxonomy. Mean, minimum, and maximum measurements for each biface type are presented in Table 4-2.

Type Descriptions

Type 1A (18 complete and 113 fragmentary specimens - Plate 4-6)
Complete specimens are elongate oval to leaf-shaped, with slightly convex edges. The fragmentary specimens exhibit parallel to slightly convex margins. The widest point on both complete and broken specimens is located above the basal one- quarter and lower than the midpoint. The bases range from straight to convex to pointed, with convex being the most common. The majority of the bifaces exhibit slightly convex edges, although many are asymmetrical in that one edge appears more convex than the other. Most of the bifaces with straight bases are due to the base being broken. Specimen 179-2, however, has been intentionally worked to form a straight base and the base on specimen 178-863 is the cortical

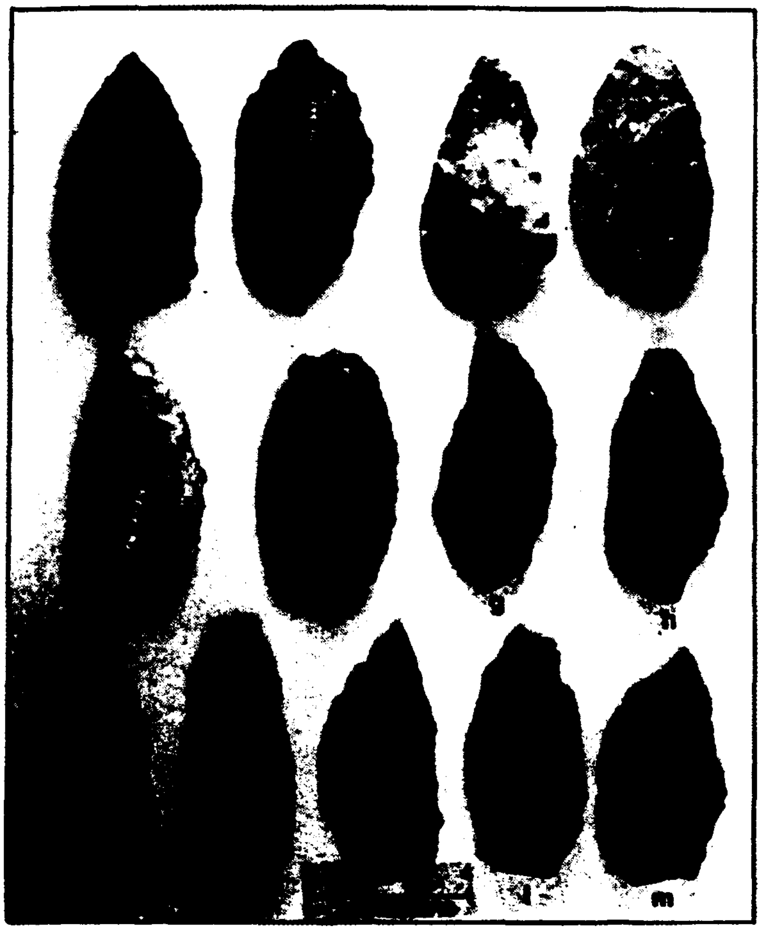


PLATE 4-6. TYPE 1A BIFACES.

PLATE 4-7. TYPE 1A BIFACES.

Table 4-2. Mean, Minimum and Maximum Measurements for Complete Bifaces.

Type/n	Length (cm)	Width (cm)	Thickness (cm)
1A/15	6.56	3.30	0.96
	6.20	2.98	0.80
	7.32	3.73	1.11
1B/5	6.76	2.52	1.54
	6.40	2.18	1.10
	7.05	2.96	1.89
2A/22	6.16	3.65	1.32
	5.90	3.07	0.95
	6.65	4.02	1.58
2B/5	5.87	3.69	1.96
	5.36	3.60	1.82
	6.31	3.81	2.10
3A/16	6.46	4.10	1.42
	5.56	3.56	1.06
	6.98	4.61	2.09
3B/7	5.53	4.12	1.65
	5.31	3.80	1.41
	5.82	4.55	1.86
3C/5	5.12	4.13	2.34
	4.96	3.74	1.90
	5.27	4.52	2.63
4A/11	4.80	4.00	1.09
	4.26	3.63	0.92
	5.25	4.35	1.32
4B/6	5.19	4.13	1.16
	5.05	3.71	1.00
	5.31	4.65	1.39
5A/11	6.19	4.52	1.27
	6.00	4.10	0.81
	6.51	4.84	1.54

Note: Mean, minimum, and maximum measurements are given for each biface type.

* = Not measured

Table 4-2. Continued.

Type/n	Length (cm)	Width (cm)	Thickness (cm)Type/n
5B/4	5.59	5.33	1.33
	5.16	4.98	1.12
	6.13	5.59	1.48
6/21	4.94	2.79	0.89
	4.55	2.59	0.57
	5.37	3.20	1.27
7A/8	4.81	2.50	1.04
	4.40	2.07	0.77
	5.80	3.10	1.25
7B/6	5.72	2.36	0.92
	5.36	2.13	0.76
	6.15	2.60	1.31
7C/13	5.18	2.92	1.02
	4.86	2.51	0.76
	5.41	3.21	1.34
8A/16	5.46	3.42	1.17
	5.00	3.17	0.56
	5.78	3.71	1.55
8B/8	5.89	3.22	0.89
	5.65	3.06	0.72
	6.31	3.38	1.18
9/3	4.85	2.75	1.06
	4.20	2.30	0.80
	5.20	3.27	1.27
10/2	6.05	3.66	1.77
	5.91	3.56	1.59
	6.19	3.76	1.95
11A/11	4.64	3.27	1.04
	4.31	2.92	0.70
	5.10	3.51	1.26

Table 4-2. Continued.

Type/n	Length (cm)	Width (cm)	Thickness (cm)
11B/6	4.44	2.85	1.71
	4.32	2.68	1.03
	4.58	3.12	2.06
11C/3	4.04	3.80	1.63
	4.00	3.58	1.53
	4.12	3.91	1.80
12A/14	4.09	2.77	0.87
	3.81	2.21	0.56
	4.75	3.12	1.18
12B/5	3.32	2.65	0.95
	3.00	2.51	0.85
	3.55	2.77	1.20
13/4	4.64	*	0.88
	4.44	*	0.83
	4.96	*	0.97
14/3	8.52	5.68	2.68
	6.15	3.58	1.41
	10.25	7.12	3.43
15/7	7.78	5.94	2.63
	7.30	5.74	2.44
??	8.41	6.50	2.89
16A/7	7.34	4.54	2.00
	7.12	3.97	1.55
	7.84	4.91	2.80
16B/8	7.60	5.08	1.69
	7.34	4.35	1.43
	7.90	5.67	2.10
16C/4	6.91	5.40	1.73
	6.82	5.17	1.38
	7.01	5.78	2.12

Table 4-2. Continued.

Type/n	Length (cm)	Width (cm)	Thickness (cm)
17A/4	6.10	5.44	2.59
	5.64	4.95	2.25
	6.65	5.78	3.38
17B/11	6.73	4.83	2.60
	6.25	3.97	2.27
	7.01	5.83	3.21
18A/6	10.48	4.69	1.68
	9.89	3.84	1.35
	11.10	5.62	2.14
18B/4	9.18	5.00	2.01
	9.00	4.55	1.28
	9.68	5.55	2.71
19A/8	7.92	3.45	1.15
	7.40	2.77	0.86
	8.36	3.82	1.56
19B/6	8.43	3.82	1.69
	8.18	3.38	1.40
	9.31	4.27	2.03
20/1	13.70	8.46	3.71
21/3	11.63	7.34	2.36
	10.89	6.96	1.45
	12.19	7.71	3.04

platform. All but possibly specimen 178-5549 have been made on a flake, with varying degrees of flaking. Specimens 178-7076 and 178-7974 exhibit heavy carbonate buildup on one face. Nine (7%) are chalcedony and 122 (93%) are basalt.

Type 1B (6 complete and 13 fragmenteary specimens - Plate 4-7)

These bifaces are long, narrow, and leaf-shaped, with nearly parallel to slightly convex lateral margins and convex to pointed bases. Thw widest point is near the center. Two specimens, 176-3 and 178-855, exhibit convex edges. Specimen 176-3 may in fact have functioned as a uniface. Specimens 178-3921 and 178-850 exhibit nearly parallel edges but are thick and fairly curde. Specimen 178-5564 resembles very closely a San Dieguito Type 1 or Type 2 biface. All complete specimens are bipointed, except 178-5564, which has a convex base. Some of the pointed basal fragments may be tips. Two complete specimens, 176-3 and 178-855, are made on flakes and three are made on cores. Four (21%) are chalcedony and 15 (79%) are basalt. asymmetrical in that one edge appears more convex than the other. Most of the bifaces with straight bases are due to the base being broken. Specimen 179-2, however, has been intentionally worked to form a straight base and the base on specimen 178-863 is the cortical platform. All but possibly specimen 178-5549 have been made on a flake, with varying degrees of flaking. Specimens 178-7076 and 178-7974 exhibit heavy carbonate buildup on one face. Nine (7%) are chalcedony and 122 (93%) are basalt.

Type 2A (29 complete and 23 fragmentary specimens - Plate 4-8)

Squat oval to slightly elongate oval with parallel to slightly convex lateral margins and widest point near the center. Nearly all complete specimens are asymmetrical with one convex edge and one straight edge. Much of the asymmetry results from fractures and, in some cases, reworking. All have convex bases and all appear to be made on flakes, except possibly specimens 178-614 and 178-777. Eight bifaces (15%) are chalcedony, tw0 (4%) are rhyolite, and the remaining 42 (40%) are basalt.

Type 2B (5 complete specimens - Plate 4-10)

Squat oval to slightly elongate oval with widest point near center. This category of bifaces is generally the same shape, length, and width as Type 2A, but thicker. They all appear to be core or split-cobble based. Two (40%) are chalcedony, one (20%) is rhyolite, and two (40%) are basalt.

PLATE 4-8. TYPE 2A BIFACES.

PLATE 4-9. TYPE 2B BIFACES.

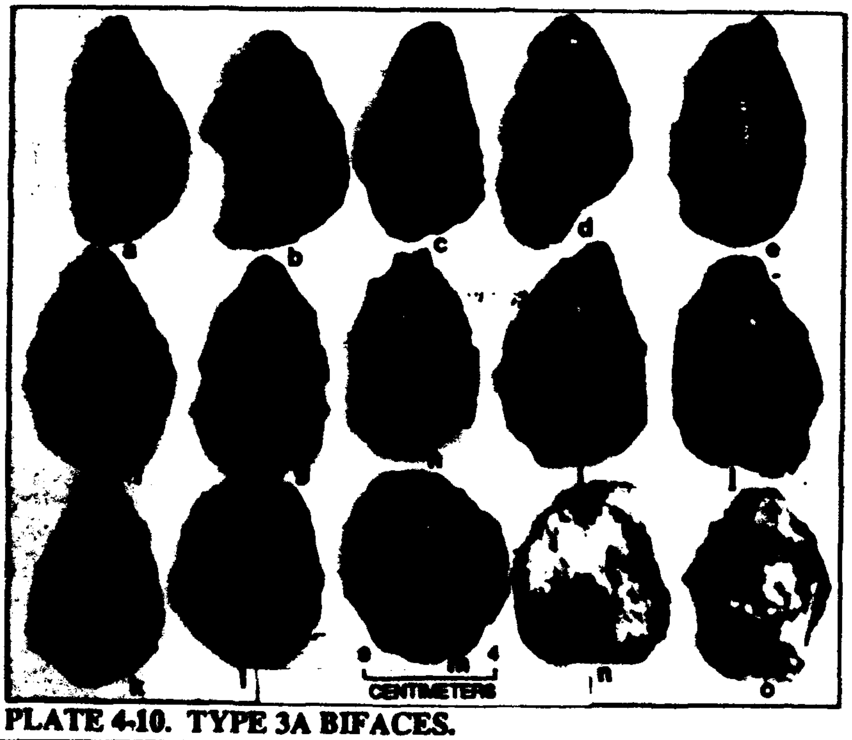


PLATE 4-10. TYPE 3A BIFACES.

Type 3A (29 complete and 33 fragmentary specimens - Plate 4-10)

Oval to elongate oval with convex edges and the point of greatest width between the base and the center. All but four have convex bases; complete specimen 178-5621 exhibits an intentionally worked straight base and specimen 178-3650 exhibits a straight base formed by a cortical platform. Nearly all the complete specimens are asymmetrical with one edge more convex than the other. Specimens 440-95, 178-956 and 440-389 appear to have been larger bifaces that broke and the edge-edge break was reworked to form one lateral edge of the biface in its present condition; 440-95 was reworked by bipolar flaking. Specimen 178-521 exhibits cortex as one lateral surface. All complete specimens are flake-based, with the exception of specimens 178-710 and 440-395. All of the basal fragments appear to be too long to have fit into this type and may better fit in tyhpe 16B, 18 or 19. Two basal fragments (178-5514, 178-1785) are pointed and may be tips rather than bases. Five (8%) are chert/chalcedony and 57 (92%) are basalt.

Type 3C (5 specimens - Plate 4-12)

These bifaces are squat oval to nearly round. Their length and width range is similar to Type 3B but they are thicker. The greatest width is near the center and the tips cannot be distinguished from the bases. All appear to be made on cores or split cobbles. Two (40%) are chalcedony, two (40%) are basalt and one (20%) is rhyolite.

Type 4A (13 specimens - Plate 4-13)

These bifaces range from squat oval to nearly triangular with the widest portion at the base. All exhibit convex edges but those that are more triangular exhibit somewhat straighter edges. The majorityh of the bases are convex, although the triangular bifaces exhibit a convex-pointed to pointed range (specimens 178-536, 178-2559, 178-4594), or a straight base (specimens 178-4930, 178-638, 178-1733, 178-4006). All are made on falkes. One (8%) is chalcedony and 12 (92%) are basalt.

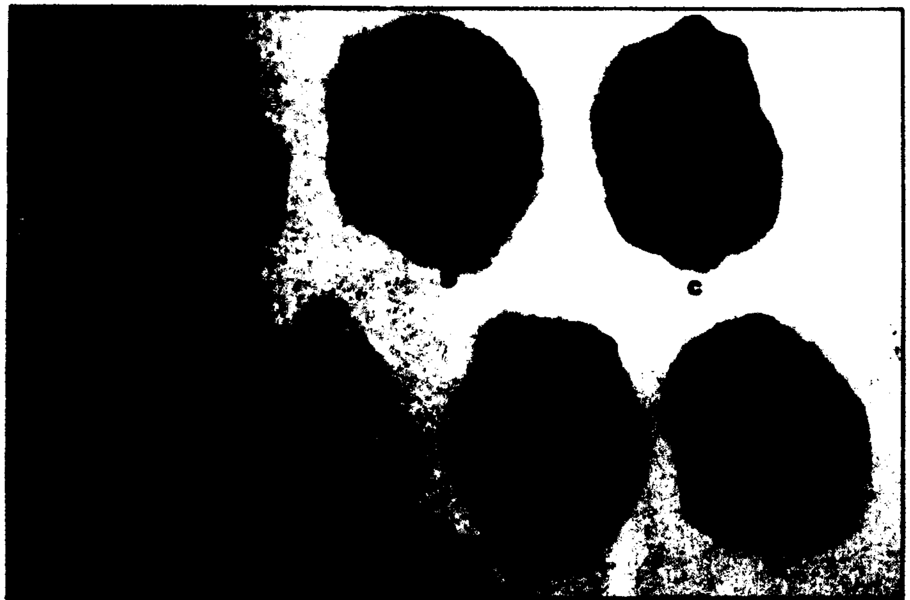


PLATE 4-11. TYPE 3B BIFACES.

PLATE 4-12. TYPE 3C BIFACES.

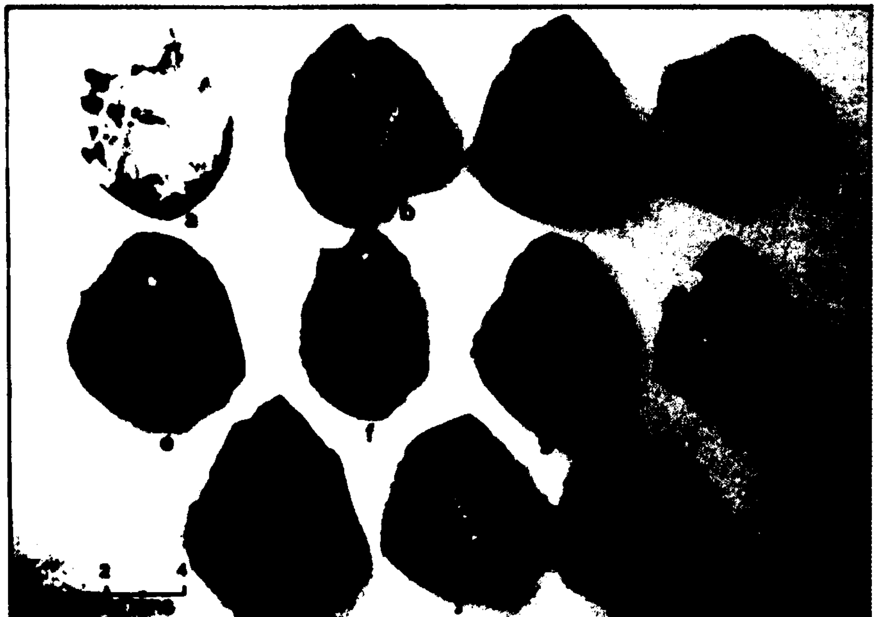


PLATE 4-13. TYPE 4A BIFACES.

Type 4B (7 specimens - Plate 4-14)

Squat oval with greatest width near the center. Three specimens (178-2844, 178-5206, 178-5050) exhibit parallel edges with straight bases, one exhibits convex edges with a straight base (178-4394) and two exhibit convex edges and convex bases (174-61, 178-4796). All are flake-based. One (14%) is chalcedony and six (86%) are basalt.

Type 5A (13 complete and 64 fragmentary specimens - Plate 4-15)

Oval with the widest point towards the center trending to more triangular at one end. All complete specimens exhibit convex bases and convex edges, except for specimen 178-5525, which exhibits straight to slightly concave edges, and specimen 178-4337, which exhibits one concave lateral surface rather than an edge. Specimen 178-5525 does not appear to belong in this category. It is rectangular in outline with straight to concave lateral edges and one straight and one convex end. Its tip appears to have been broken and reworked forming a straight unifacial working edge. The basal fragments also exhibit a variety of edge shapes. Approximately 20 of the fragmentary specimens have estimated lengths too large to fit this category as based on complete specimens. The ranges of their widths and thicknesses are appropriate for this type but their projected lengths seem more characteristic of types 16B and 18A. Specimen 178-6455 is heavily weathered with a carbonate accretion. All complete specimens appear to be flake-based except specimen 178-4337. Six (8%) are chert/chalcedony and 71 (92%) are basalt.

Type 5B (4 complete and 8 fragmentary specimens - Plate 4-16)

These bifaces are slightly shorter and wider than Type 5A and are triangular to nearly discoidal in outline. Complete specimens exhibit convex to straight edges, straight or nearly straight bases, and the widest portion at the base. Two of the bases appear to be platforms (178-4576, 178-4510), exhibiting cortical surfaces. All of the basal fragments are less than one-quarter complete and consequently the edge shape can not be determined with certainty. However, the widths and thicknesses of the fragmentary specimens fall within the ranges exhibited by the

PLATE 4-14. TYPE 4B BIFACES.

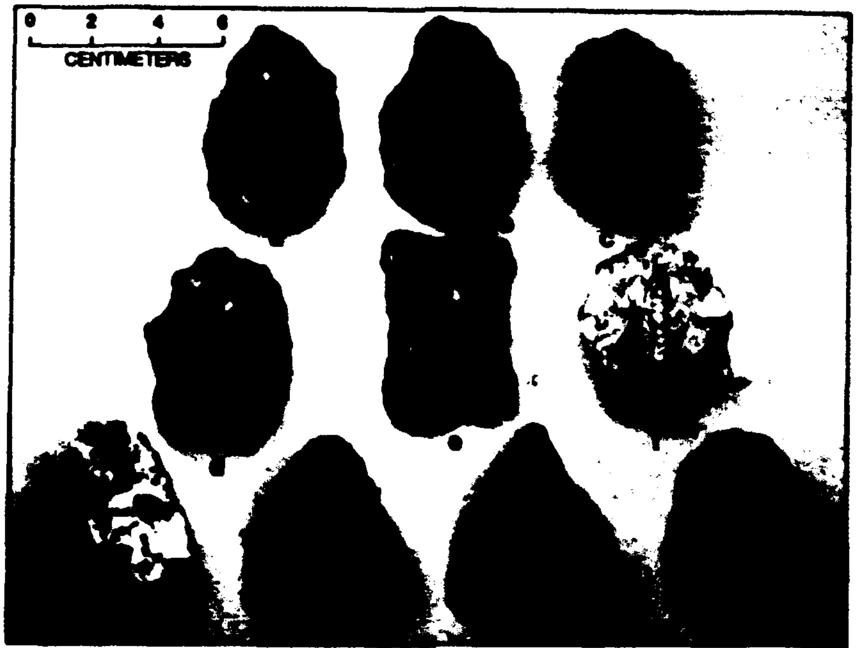


PLATE 4-15. TYPE 5A BIFACES.

complete specimens. All are probably made on flakes. One (8%) is chert/chalcedony and 11 (92%) are basalt.

Type 6A (26 complete and 25 fragmentary specimens - Plate 4-17)
Elongate oval to leaf shaped with the widest point near the center. Twelve complete specimens exhibit nearly parallel, slightly convex edges. The remaining six specimens (178-498, 178-795, 178-4777, 178-3559, 178-5507, 178-4362) are asymmetrical in that they exhibit one convex and one straight edge. Seventeen complete and four fragmentary specimens exhibit convex bases, and one complete specimen (178-498) and 21 basal fragments exhibit straight bases. On many specimens it is difficult to distinguish the tip from the base because the tips are so rounded and blunt and one basal fragment may be a tip. All appear to be flake-based. One (2%) is chalcedony, one (2%) is a black felsite, and 49 (96%) are basalt. Only two specimens (178-4003, 178-5507) exhibit carbonate accretions.

Type 6B (10 fragmentary specimens - No Illustration)
These bifaces are distinguished from Type 6A because they are much thinner than the complete Type 6A bifaces. Most do fall within the range of the Type 6A thickness, but they are all on the lower end of the scale. Three (30% exhibit straight bases and the remaining seven (70%) have convex to convex-pointed bases. One (10%) is chert/chalcedony and nine (90%) are basalt.

Type 7A (9 complete specimens - Plate 4-18)
Elongate oval to leaf shaped with the greatest width near the base, although two specimens (178-3644, 440-519) exhibit the widest portion more toward the center. Six specimens exhibit slightly convex edges and one (180-225) exhibits one straight and one convex edge. All exhibit convex bases; the base of specimen 440-519 is nearly pointed. All are made on flakes and the bases on specimens 178-606 and 178-2070 are flake platforms. Two (22%) are chalcedony and seven (78%) are basalt.

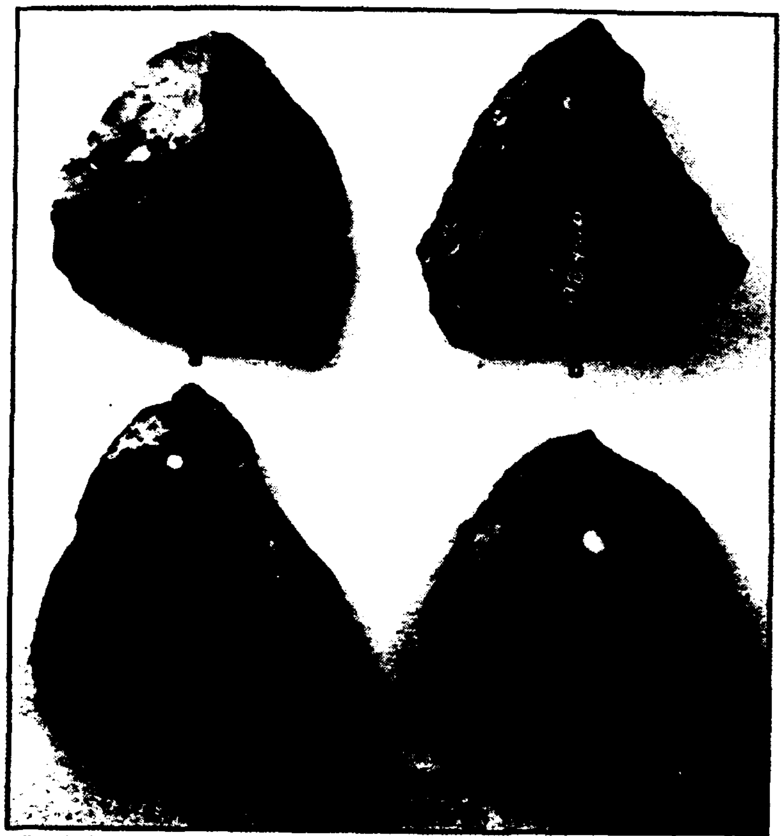


PLATE 4-16. TYPE 5B BIFACES.

PLATE 4-17. TYPE 6A-BIFACES.

Type 7B (6 complete and 2 fragmentary specimens - Plate 4-19)
Leaf-shaped to elongate leaf-shaped with the widest point near the center in four specimens (178-14, 174-48, 174-324, 178-5696), and near the base in two (178-528, 178-3708). All exhibit convex edges, except specimen 178-528, which exhibits one convex and one concave edge. All have convex or convex-pointed bases except specimen 178-528, which has a straight base that is a cortical flake platform. Two bifaces (174-48 and 178-3708) appear to be core or cobble-based; the remainder are flake-based. All but two specimens (178-528, 178-48) exhibit some carbonate deposits. Two (25%) are chalcedony, one of which is possibly petrified wood; the remaining six (75%) are basalt.

Type 7C (16 complete and 1 fragmentary specimens - Plate 4-20)
Elongate oval to nearly leaf shaped, most with the widest point in the bottom one-third of the biface, although four specimens (178-3800, 440-336, 178-804, 178-854) exhibit the greatest width near the center. Bases are generally convex, although specimens 178-3759 and 178-854 exhibit straight bases. All exhibit convex edges, except specimens 178-3800 and 440-78, which exhibit one convex and one straight edge. Specimens 440-336 and 174-46 appear to be reworked from larger bifaces where the distal end broke and was reworked to form a lateral edge. Specimen 178-3800 may be a drill. The single fragmentary specimen has a projected length that falls outside the range of complete specimens. All appear to be flake-based, with the possible exception of specimen 178-463, which may be made on a core or split-cobble. Specimen 178-3800 exhibits some carbonate deposit. Two (13%) are chalcedony and 14 (87%) are basalt.

Type 8A (22 complete and 17 fragmentary specimens - Plate 4-21)
Oval to elongate oval with the greatest width just below the center. All exhibit convex (nearly straight to nearly pointed) bases, except specimen 178-1662, which exhibits a straight base. All exhibit convex edges except specimens 440-66 and 178-1622, which exhibit one convex and one straight edge. The basal fragments and exhibit very convex edges and convex bases such that the widest portion would be near the base. Two basal fragments have straight bases and 15 have convex bases. The projected length of one specimen (178-5502) is too long to fall within the range of the complete specimens. All appear to be flake-based, although some may be split

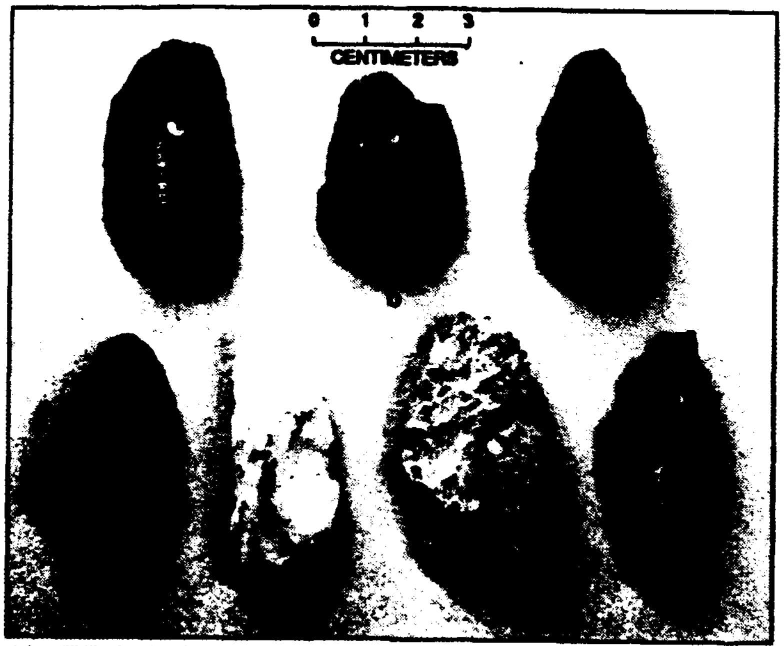


PLATE 4-18. TYPE 7A BIFACES.


PLATE 4-19. TYPE 7B BIFACES.

PLATE 4-20. TYPE 7C BIFACES.

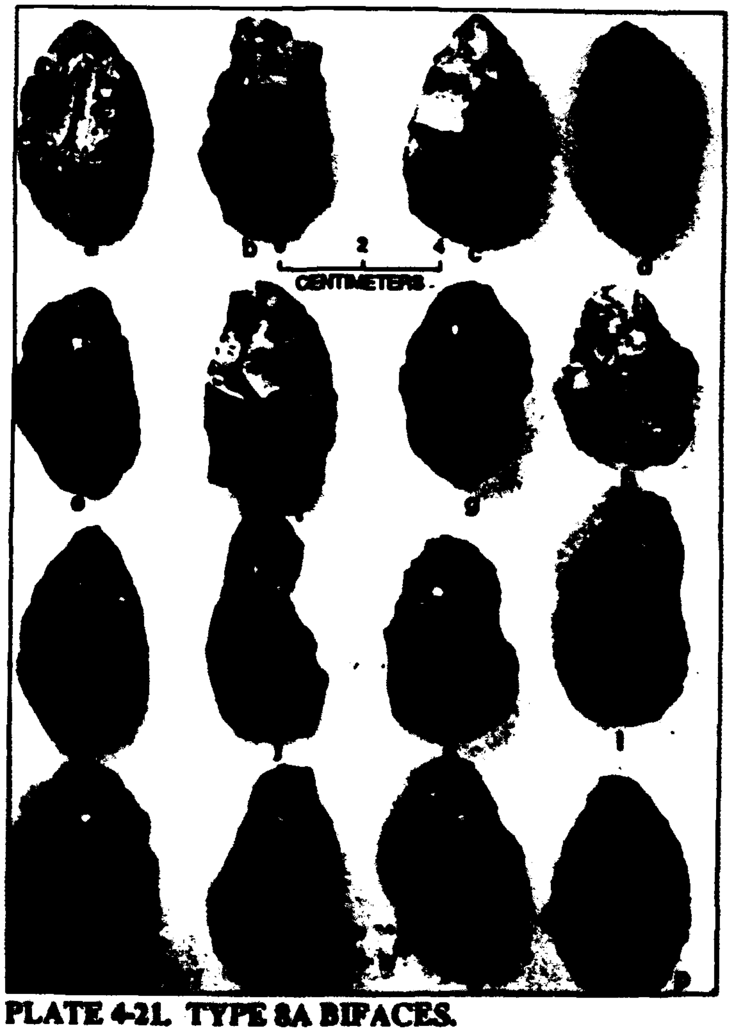


PLATE 4-21. TYPE 8A BIFACES.

cobble-based. Unlike most flake-based bifaces where the platform forms the base, specimen 178-1898 has the platform at the tip. One specimen (178-817) may be a midsection. Four (10%) are chalcedony, one (3%) is quartz and 34 (87%) are basalt.

Type 8B (7 complete and 15 fragmentary specimens - Plate 4-22)
Elongate oval with the greatest width near the center. Complete specimens exhibit slightly convex edges and straight bases. The base shape is due to it being the flake platform on four specimens (174-20, 178-851, 178-5497 and possibly 178-5499) and due to a fracture and reworking on one specimen (178-5689). Specimen 440-371 exhibits the platform on the tip. All appear to be flake-based. The fragmentary specimens exhibit straight (2) to convex (13) bases. One fragmentary specimen (178-361) may be a tip, and one (440-384) may be a tip or midsection. Specimens 174-20, 178-5497 and 178-5499 all exhibit slight carbonate deposits. One (5%) is rhyolite and 21 (95%) are basalt.

Type 8C (9 complete specimens - Plate 4-23)
Leaf-shaped with slightly convex to parallel edges and convex to convex-pointed bases. These bifaces exhibit very little working, particularly on the ventral face, and their form depends primarily on the shape of the flake. Unlike most bifaces, the lateral edges of these are formed by reducing the distal and proximal ends of the flakes. Specimen 440-224 is formed from a "citrus-slice" flake with one lateral edge being the cortical surface from tip to base, and the other lateral edge only lightly flaked on the dorsal surface. Specimen 178-5173 is nearly unifacial with the tip having been retouched unifacially to form a graver-like tip. All nine of these bifaces are basalt.

Type 9 (3 complete specimens - Plate 4-24)
One specimen 178-3576 was not relocated after the initial analysis. The remaining two (440-174, 178-815) are bipointed with convex edges and the greatest width at the center. There is considerable difference in length; 440-174 is squat (4.20 cm in length) and 178-815 is elongate (5.20 cm in length). Nearly all of the flaking is unifacial. One (33%) is chalcedony and two (67%) are basalt.

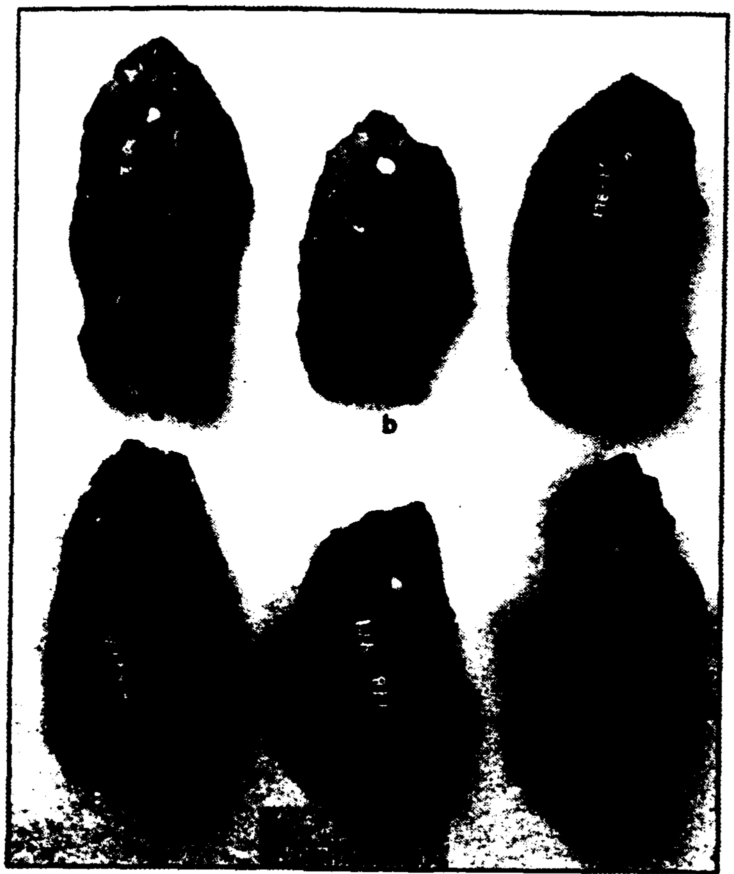


PLATE 4-22. TYPE 8B BIFACES.

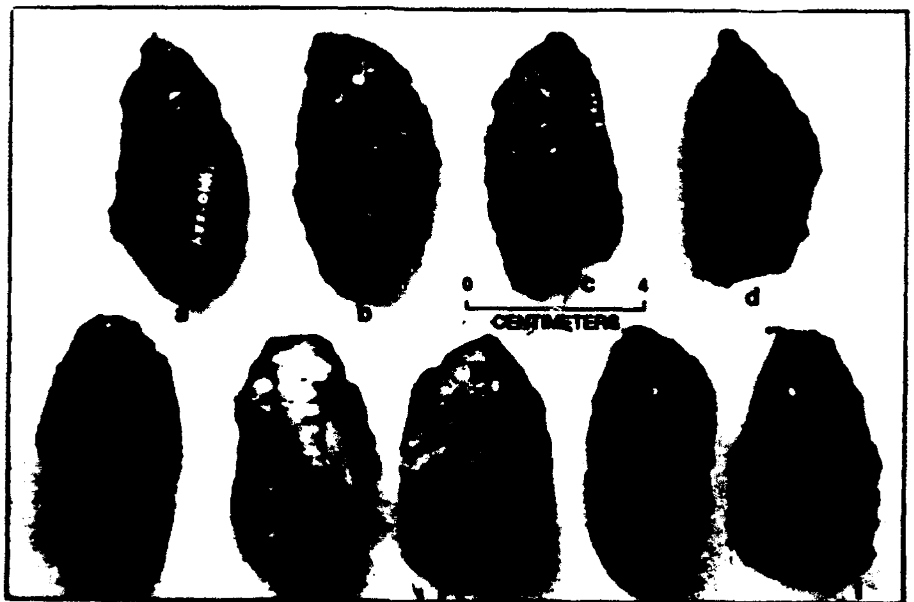


PLATE 4-23. TYPE 8C BIFACES.

Type 10 (4 complete specimens - Plate 4-25)

Oval in outline with convex edges and the greatest width toward the base (180-245) or with parallel edges and the greatest width at the center (178-4637). Bases are convex. One (23%) is jasper and three (75%) are basalt.

Type 11A (16 complete specimens - Plate 4-26)

Small oval to squat oval with the greatest width near the center, except for two specimens (440-367, 178-2643) on which the widest point is near the base. Edge outlines are varied: four specimens (178-2643, 178-4678, 178-2066, 178-5399) exhibit one convex and one straight edge; three specimens (440-367, 178-5427, 178-3570) exhibit nearly straight, parallel edges; the remaining three specimens (178-216, 178-2231, 178-4486) exhibit convex edges. All exhibit convex bases and all appear to be made from flakes. Three (19%) are chalcedony and 13 (81%) are basalt.

Type 11B (7 complete specimens - No Illustration)

Squat oval to nearly leaf-shaped, with the greatest width near the center. These bifaces are thick for their length and width, except specimen 178-3953 which is thin and does not belong in this type. The bases are convex except specimen 178-4093 which has a straight base. These bifaces are core or split-cobble-based except 178-3953, which is flake based. Three (43%) are chalcedony, and four (57%) are basalt.

Type 11C (3 complete specimens - Plate 4-27)

These bifaces are small and thick and nearly discoidal. Specimens 178-4025 and 178-853 are very similar in flaking pattern and outline. Specimen 178-3564 is more discoidal with a more regular outline than the other two. All may be flake-based, but this is difficult to determine. One (33%) is chalcedony, two (67%) are basalt.

Type 12A (18 complete and 5 fragmentary specimens - Plate 4-28)

Squat oval with the greatest width in the bottom one-third of the biface. These bifaces are more symmetrical than other types and in many typologies might be included with the projectile

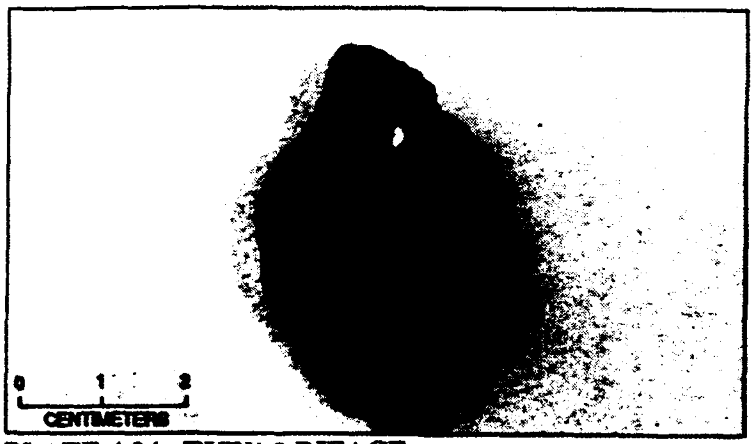


PLATE 4-24. TYPE 9 BIFACE.

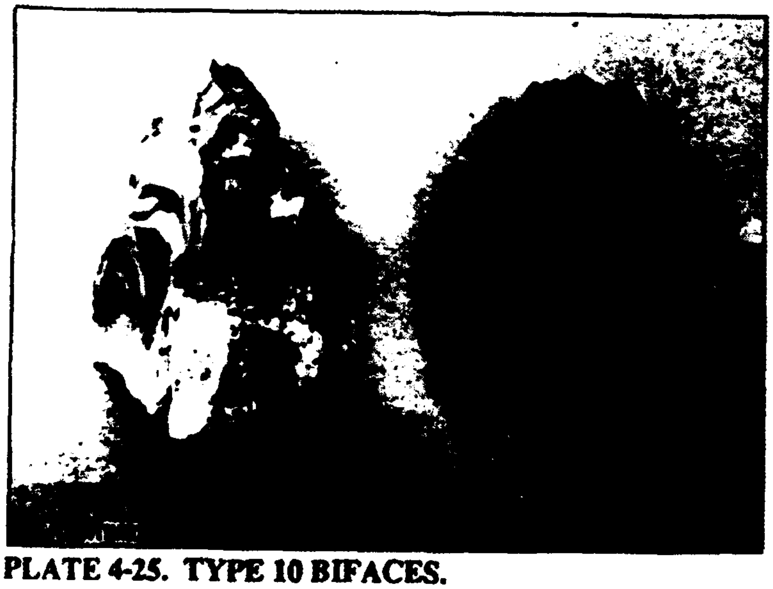


PLATE 4-25. TYPE 10 BIFACES.

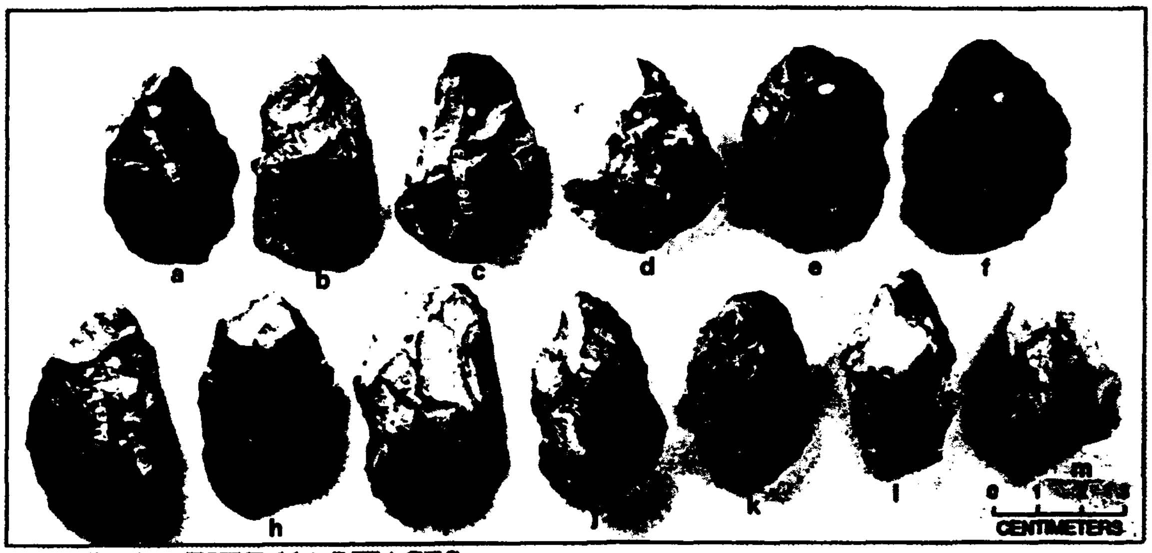


PLATE 4-26. TYPE 11A BIFACES.

PLATE 4-27. TYPE 11C BIFACES.

PLATE 4-28. TYPE 12A BIFACES.

points. The majority of the complete specimens exhibit convex edges with convex bases, and all fragmentary specimens exhibit convex edges Specimens 440-190, 178-3552, and 178-2722 have straight bases, specimens 178-5141 and 178-4058 exhibit combinations of convex and straight edges with the greatest width at the center, tapering towards the base, with a straight base. On specimen 178-5141, the base is the cortical flake platform. Specimen 178-5323 (quartz) is possibly a bipolar core. All are probably flake-based. This group contains the greatest variability in material type: two (9%) chalcedony, one (4%) jasper, one (4%) felsite, one (4%) quartzite, two (9%) quartz, and 12 (70%) basalt.

Type 12B (5 complete specimens - Plate 4-29)
Extremely small, squat oval with the greatest width at the bottom one-third of the biface. Most exhibit convex edges, although specimen 178-550 exhibits one convex and one straight edge. Three have straight bases, although the base of specimen 178-550 may be a fracture; two exhibit convex bases. All are flake-based and all are basalt.

Type 13 (4 complete specimens - Plate 4-30)
The only apparent similarity between the bifaces in this type are their asymmetry and the fact that each has a fracture along one lateral margin.

Type 14 (2 complete specimens - Plate 4-31)
Both specimens are medium-large, oval bifaces with sinuous combination shaped lateral edges and convex bases. Both are chalcedony, exhibit natural lateral surfaces, nonpatterned flaking, and retain some cortex. They appear to be unfinished Stage II bifaces rather than finished tools.

Type 15 (10 complete specimens - Plate 4-32)
Four are medium-large, oval in shape, with the greatest width toward the bottom, but specimens 181-304 and 178-6826 exhibit the greatest width in what appears to be the upper one-third. Specimen 440-222 is more leaf-shaped with the greatest width in the center. Edges are convex with convex bases, although not well patterned. Specimens 440-196 and 440-445 appear to be further along in the reduction process and are intentionally shaped. All of them except specimen

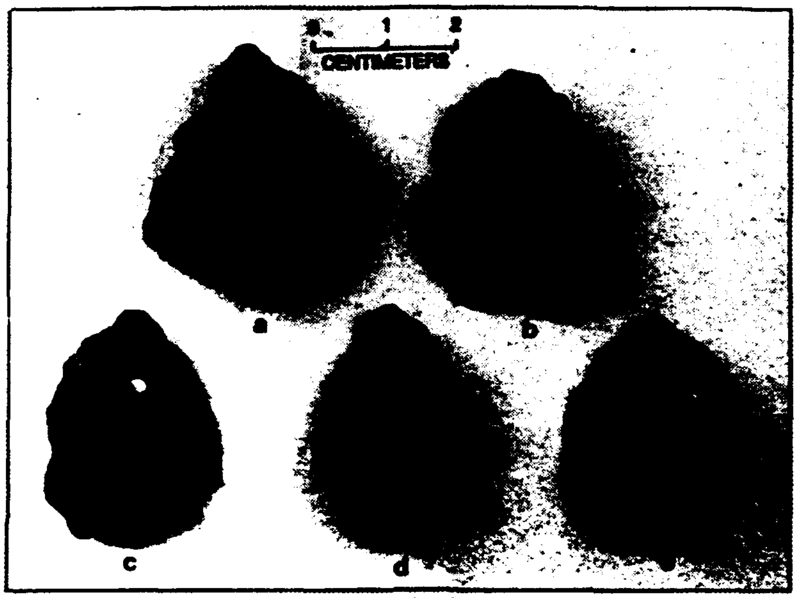


PLATE 4-29. TYPE 12B BIFACES.

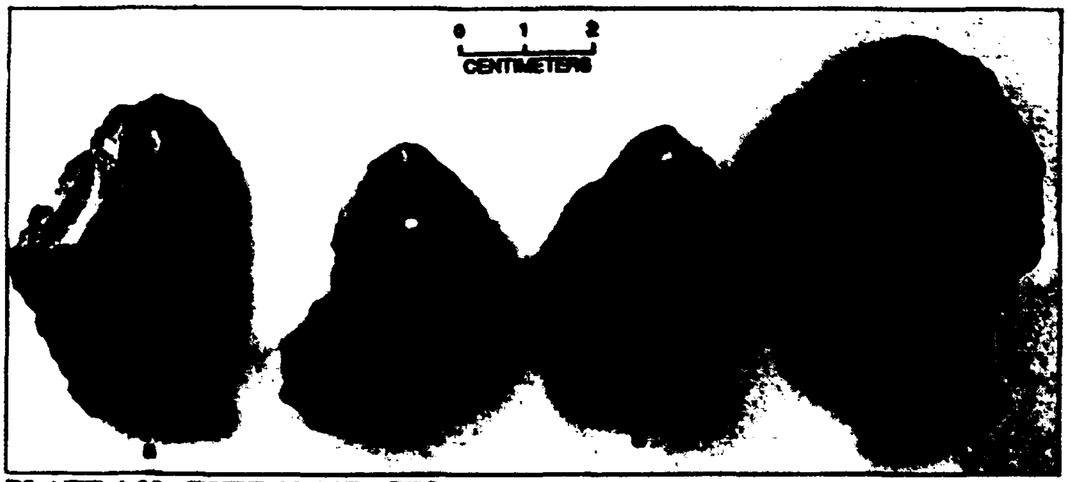


PLATE 4-30. TYPE 13 BIFACES.

178-6826 exhibit cortex; this specimen is also heavily weathered and exhibits carbonate deposits. The majority appear to be flake-based or possibly split-cobble (macroflake) based, except specimens 440-445 and 440-196, which seem to be core-based. One (10%) is chalcedony and nine (90%) are basalt.

Type 16A (8 complete and 8 fragmentary specimens - Plate 4-33)
Oval to bipointed with the greatest width in the bottom one-third of the biface. All complete specimens exhibit convex edges but base shapes vary. Specimen 174-30 has a pointed base; specimens 178-4979 and 178-4954 have straight bases and specimens 178-4020, 178-7910 and 178-4745 have convex bases. All appear to be flake-based, and two specimens with straight bases may have flake platforms at the base. The fragmentary specimens have slightly convex bases and nearly parallel edges. One specimen (174-8) may not be a base at all, but a bipolar core. Specimen 178-4745 (chalcedony) exhibits a heavy caliche deposit and specimens 178-4954, 178-4929 and 174-30 exhibit a light carbonate deposit. Six (37.5%) are chert/chalcedony and nine (62.5%) are basalt.

Type 16B (11 complete and 26 fragmentary specimens - Plate 4-34)
These bifaces are varied in outline, but are wider and slightly thinner than type 16A. Two specimens (440-313 and 178-4354) are oval with convex edges and convex bases; specimens 178-3637 and 178-4783 are nearly rectangular with nearly parallel edges and slightly convex bases and tips; specimen 178-3745 is rectangular, but the "tip" flares out; specimen 178-3674 is diamond-shaped with one lateral edge of the "blade" formed by a reworked fracture. All are flake-based. The basal fragments exhibit little uniformity in edge outline. Some of them might not even be biface bases. Specimen 181-37 may be a uniface; 178-3609 may be debitage; 178-3621 may be a midsection; 178-4043 may be a bipolar core; 178-4601 is an outrepasse face; and 178-820 may be a complete biface. Seven basal fragments exhibit straight bases, three are pointed and 16 are convex. Five (14%) are chert/chalcedony, and 32 (86%) are basalt.

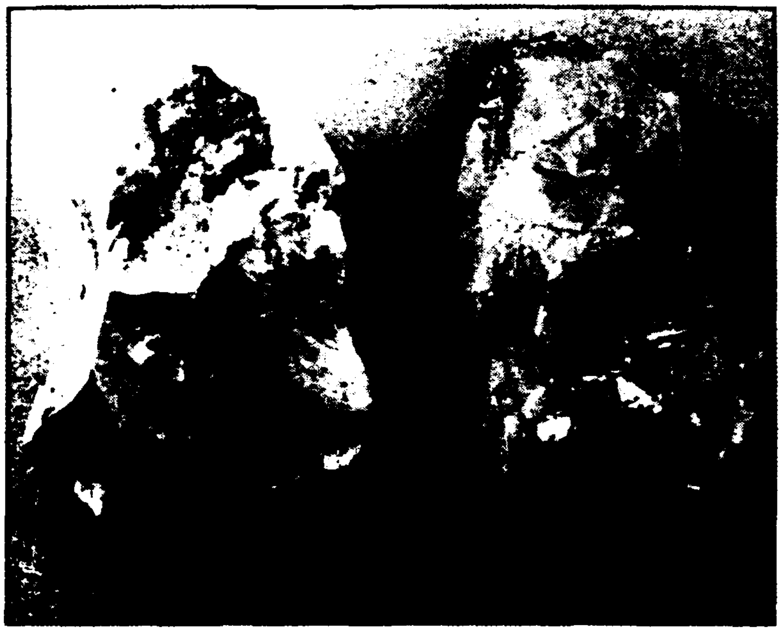


PLATE 4-31. TYPE 14 BIFACES.

PLATE 4-32. TYPE 15 BIFACES.

Type 16C (5 complete and 9 fragmentary specimens - Plate 4-35)
The complete Type 16C bifaces are squat oval with convex edges and convex bases and are shorter and wider than the rest of the Type 16 bifaces. They are all flake-based and three exhibit cortex: on specimens 178-4723 and 178-703 the bases are cortical platforms. The fragmentary Type 16C bifaces are problematical in several instances. Of the two most nearly complete specimens, one (178-3604) exhibits bipolar reworking of the fracture and may not actually be a biface base and the other specimen (178-2281) may be debitage. A third specimen (178-7571) retains the original flake platform; very little working is evident on the ventral face suggesting that it may not be a biface. If these are all biface bases, two exhibit straight bases and seven convex bases. One (7%) is chert/chalcedony and 13 (93%) are basalt.

Type 17A (6 complete specimens - Plate 4-36)
These bifaces are nearly discoidal, thick, medium-sized, except specimen 178-340 which is more leaf-shaped. Specimens 440-53 and 178-610 (both chalcedony) are core based or may be cores. The remainder, which are basalt, appear to be flake-based. Specimen 178-340 exhibits some carbonate deposit, and specimen 178-7546 is heavily weathered and has carbonate deposit. Three (50%) are chalcedony and three (50%) are basalt.

Type 17B (11 complete specimens - Plate 4-37)
These bifaces are longer and narrower than Type 17A. They are oval to elongate oval, although specimens 178-4729 and 178-860 are nearly diamond-shaped. The majority exhibit convex edges and convex bases, although the bases of specimens 178-773, 178-811 and 178-6730 are nearly straight and specimen 178-5063 exhibits nearly parallel edges and a nearly straight tip. Most of these bifaces are probably cores. All are cobble-based, making use of fairly small cobbles. Specimens 178-4448, 178-4729, 178-6730 and 178-5063 in particular seem to be cores and share a specific reduction technique, consisting of taking a small, subrounded cobble, using a natural surface area as the platform and striking it with the bipolar technique. This results in one portion of the biface exhibiting one edge or base with the natural cobble surface retained, creating a thick cross section and stacked step fractures. Five (45%) are chalcedony and six (55%) are basalt.

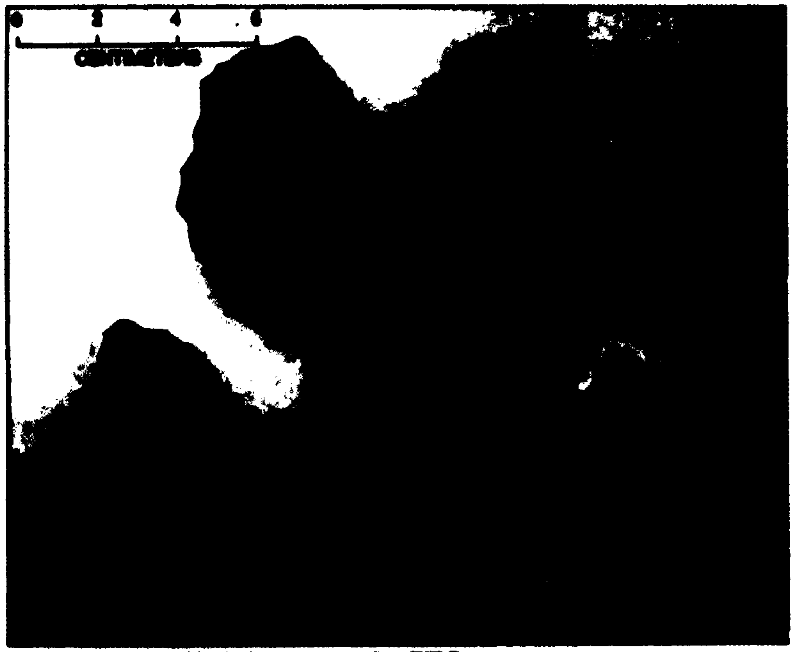


PLATE 4-33. TYPE 16A BIFACES.

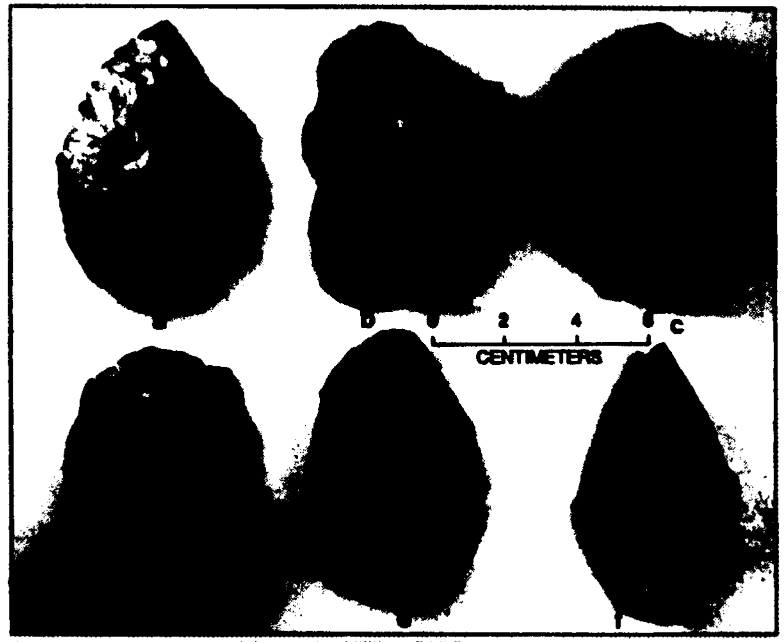


PLATE 4-34. TYPE 16B BIFACES.

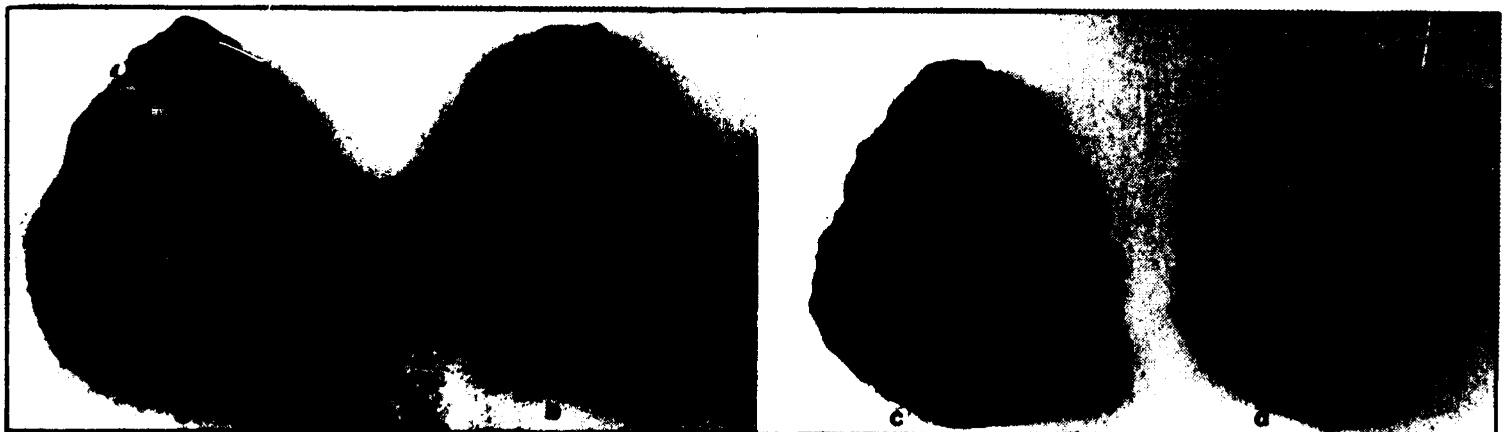


PLATE 4-35. TYPE 16C BIFACES.

PLATE 4-36. TYPE 17A BIFACES.

PLATE 4-37. TYPE 17B BIFACES.

Type 18A (8 complete and 130 fragmentary specimens - Plate 4-38)

Elongate oval and leaf-shaped with the greatest width toward the center. The majority of the bifaces exhibit convex edges and convex bases, but the shape of specimen 178-4837 results from fractures. The bases of specimens 178-31 and 178-7 are nearly straight. Specimen 178-1849 is formed from the base of a larger biface that broke and the fracture was reworked to form one lateral edge. All of these bifaces, with the possible exception of specimen 178-3716, are flake-based. Three of the seven complete bifaces have lateral snaps near the center of the biface, but both halves were recovered and refitted. There is a great deal of uniformity of form exhibited in the basal fragments. They have convex bases that merge with the convex edges without a break in the line of the edge. Some of the fragments are problematical, however; nine specimens (178-5139, 178-4444, 178-4653, 178-4629, 178-5481, 178-5463, 178-538, 440-67, 174-450) are possibly tips, specimen 178-1629 may be a uniface, specimens 178-68 and 178-5139 have projected length that are too great for Type 18A, and specimen 178-4776 appears to be too small for Type 18A. Thirteen (9.4%) are chert/chalcedony, one (0.7%) is felsite, two (1.4%) are rhyolite and 122 (88.4%) are basalt.

Type 18B (6 complete and 44 basal fragments - Plate 4-39)

The complete specimens of this group are slightly shorter than those of Type 18A. They are leaf-shaped except specimen 178-779, which is more oval. They exhibit convex edges and convex bases that are the same shape as the tip. All are flake bases except specimen 440-327. There appears to be little uniformity in outline of these basal fragments. Seven exhibit straight bases, two pointed bases and 37 convex bases. Many of these specimens appear to be too large for this category; their width and thickness measurements are right at the maximum for this type and their projected length is too great. No other category, however, would provide a closer fit. This group has more specimens with cortex on them than any other category. One specimen (2%) is felsite, six (12%) are chert/chalcedony and 43 (88%) are basalt.

Type 18C (133 basal fragments - No Illustration)

This is a new category created for bases which fit within the range of widths and projected lengths for types 18A or 18B, but are too thin. The majority of these bases are estimated to be

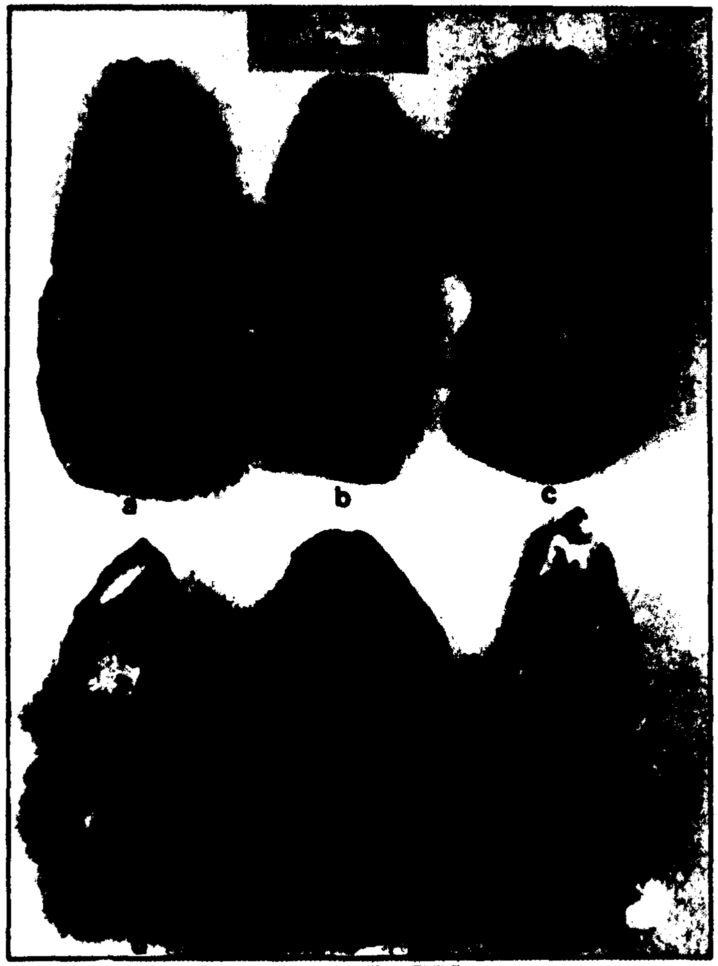


PLATE 4-38. TYPE 18A BIFACES.

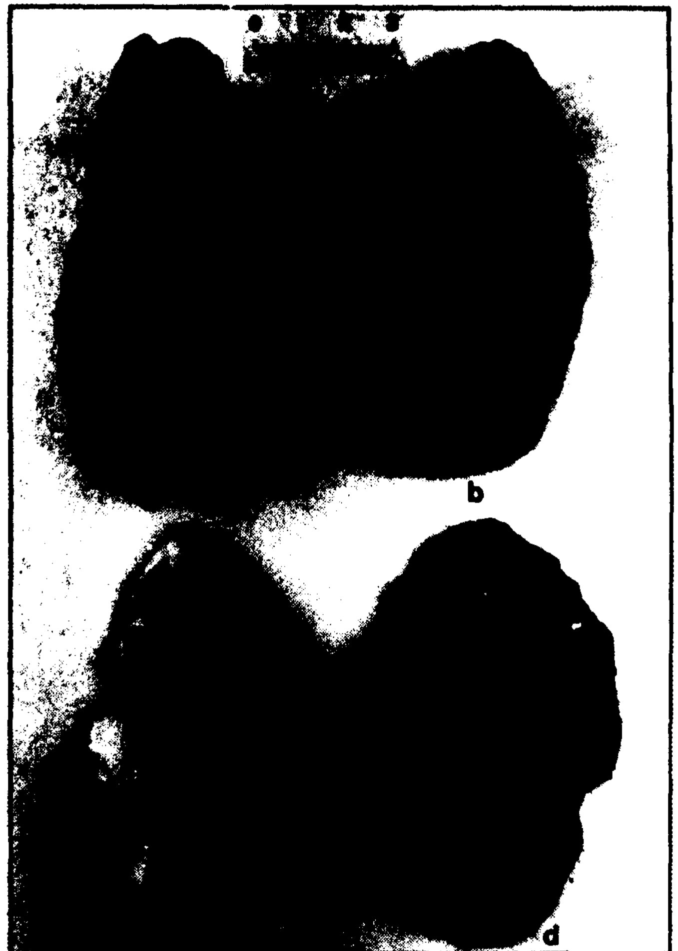


PLATE 4-39. TYPE 18B BIFACES.

less than one-half complete. Within this group there is little uniformity of edge outline, but on the whole they appear to exhibit more convex edges than those that are estimated to be at least one-half complete. Of these latter, the majority exhibit nearly parallel to slightly convex lateral edges and nearly straight to slightly convex bases. At least 14 specimens (178-647, 178-1160, 178-36, 440-141, 178-5388, 178-5593, 178-3736, 178-5554, 178-3977, 178-40, 178-4391, 178-5580, 178-5829, 180-386) are more likely tips than bases, at least three specimens (178-4173, 180-420, 178-387) are possibly debitage rather than bifaces, and one specimen (178-2321) is possibly a uniface. Two specimens exhibit convex pointed bases, 23 straight bases, and 108 convex bases. Four specimens (3%) are chert/chalcedony, one (1%) is rhyolite, and 127 (96%) are basalt.

Type 19A (12 complete and 158 fragmentary specimens - Plate 4-40)
Complete specimens are elongate oval to leaf-shaped, with the greatest width toward the center. Specimens 178-4466 and 180-7 have the greatest width toward the base. Edges are convex with convex to convex-pointed bases. Specimens 178-4466 and 180-7 have nearly straight edges that flare out near the base. Specimens 178-611 and 178-4377 are asymmetrical with one convex or one straight edge. All appear to be flake-based and all are basalt. The 158 basal fragments include a number of problematical specimens. Many are either slightly too wide and/or too thin to fall within the width and thickness range of the complete specimens. There are a number of other specimens that may belong in another category because their reconstructed lengths are too long and fall outside the length range for the complete specimens. The following specimens may belong in Type 18A: 181-336 and 440-132; the following in 18C: 178-4206, 178-4324, 178-4856, 178-4512, 174-71, 178-5612, and 178-4; the following specimen in 19B: 178-4265. Twenty-three specimens may be tips rather than bases (176-1, 440-221, 178-3418, 178-7692, 178-4005, 440-330, 174-47, 440-460, 178-4014, 178-3590, 178-1464, 174-9, 178-4239, 178-20, 178-4518, 440-9, 178-5448, 178-4324, 178-4856, 178-5657, 178-5528, 178-4512, 174-7). One specimen (178-580) may be debitage, an outrepasse flake from biface thinning. Three specimens exhibit convex-pointed bases, 27 straight bases and 128 convex bases. Thirteen (7.6%) are chert/chalcedony, one (0.6%) is a meta-sedimentary and 156 (91.7%) are basalt.

PLATE 4-40. TYPE 19A BIFACES.


PLATE 4-41. TYPE 19B BIFACES.

Type 19B (8 complete and 11 fragmentary specimens - Plate 4-41)
Slightly longer, wider and thicker than Type 19A but are generally the same shape. All appear to be flake-based. Four (21%) are chalcedony and fifteen (79%) are basalt.

Type 20A (2 specimens - Plate 4-42)
Very large bifaces made on cores. Oval shaped with convex edges and nearly straight bases. On one specimen one lateral edge and the tip constitutes a cortical natural surface.

Type 20B (3 basal fragments - No Illustration)
This category was created because these specimens are wider than the widest complete Type 20A biface, but thinner. The width of two specimens may have increased beyond the break. Two specimens may be tips rather than bases. All three specimens are basalt.

Type 21 (5 complete and 24 fragmentary specimens - Plate 4-43)
The complete specimens are oval with convex edges and convex bases. Two specimens (181-370, 180-503) are large and thick and are core or split-cobble based. Specimen 178-4824 is large but made on a very thin flake and exhibits minimal working. Nearly one-half of the basal fragments are wider than the widest of the complete specimens but thinner than the complete specimens of Type 20. One specimen (178-1176) is possibly a tip; its projected length is greater than the complete specimens of this type. Another specimen (179-74) is possibly a uniface. Five of the fragments exhibit straight bases and 19 have convex bases. Nearly one-half of the fragmentary specimens exhibit cortex along one margin or on the base and exhibit margin surfaces rather than margin edges and are most likely early stages of biface production. Two (7%) are chert/chalcedony, one (3%) is rhyolite and 26 (90%) are basalt.

Type 22A (30 basal fragments - No Illustration)
These basal fragments exhibit nearly parallel edges. Of these, 21 (70%) have straight bases and nine (30%) have convex bases, a ratio very different from other biface types. These bifaces are narrow and thin relative to their projected length; however, the narrowest, thinnest and shortest

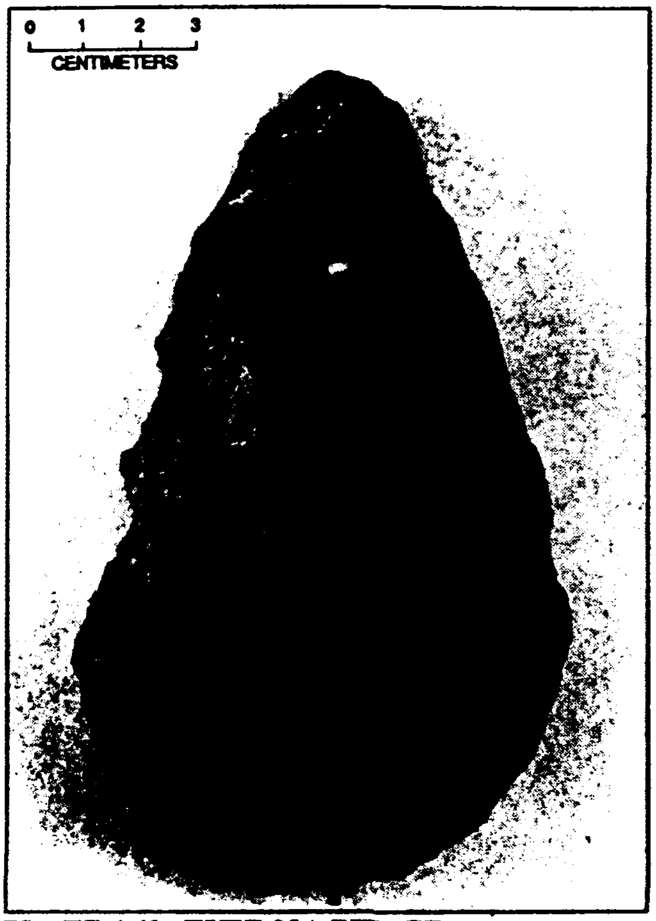


PLATE 4-42. TYPE 20A BIFACE.

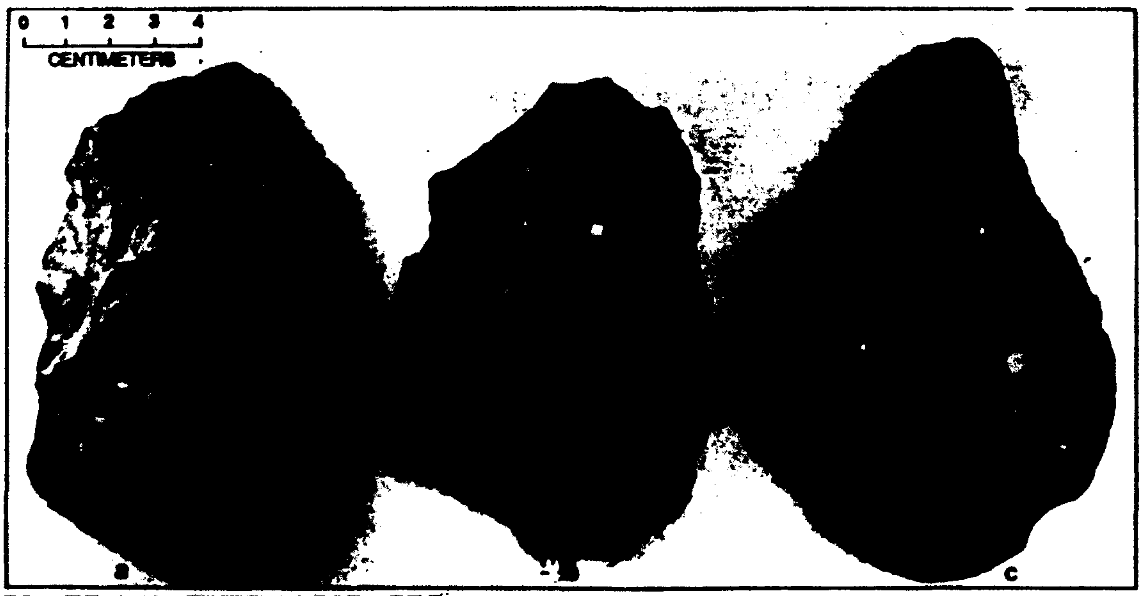


PLATE 4-43. TYPE 21 BIFACES.

(estimated length) may better fit in Type 8A: 174-447, 178-847, 178-542, 178-3682, 178-1320. Seven (23%) are chalcedony and 12 (75%) are basalt.

Type 22B (16 basal fragments - No Illustration)
The specimens of this category are wider than those of Type 22A, but are similar in thickness and projected length. They are very thin relative to their length and width, but not particularly better made than many other types. Most appear to be less than one-half complete. All exhibit straight bases and nearly parallel edges. Four (25%) are chalcedony and 12 (75%) are basalt.

Type 23 (36 basal fragments - No Illustration)
This category includes bifaces that are wider and slightly thicker than types 22A and 22B, but not as wide nor as thick as the two larger types, 20 and 21. These bifaces are crude and many of them have cortex on one face and/or the base. The majority of them are estimated to be only about one-quarter complete, but appear to have convex lateral edges. Six (17%) exhibit straight bases and 30 (83%) exhibit convex bases. All are basalt.

Type 24A (23 basal fragments - No Illustration)
Bifaces of this category are wide, thick, and long, but not as wide as types 20 and 21. They exhibit a thickness range similar to Type 21, but the estimated lengths are longer than those of Type 21. There is little uniformity in outline among these bifaces. All but four exhibit convex bases, two (178-423, 178-3643) may be tips. A large number of specimens (11) exhibit cortex, generally covering one face. Three (13%) are chert/chalcedony and 20 (87%) are basalt.

Type 24B (10 basal fragments - No Illustration)
These basal fragments have a width range and projected length range similar to Type 24A, but are thinner. Most are estimated to be less than one-third complete, and appear to have convex edges. Five exhibit cortical bases and 12 have convex bases. All are basalt.

Type 25 (27 basal fragments - No Illustration)

These bases are slightly narrower in width and slightly thinner in cross section than Type 18A, but appear to have a similar length range. The specimens are quite uniform in outline with convex bases and nearly parallel to slightly convex edges. All are estimated to be between one-third and one-half complete. Six specimens (178-1639, 178-1591, 178-5663, 178-3625, 178-5620, 440-414) may be tips. All are basalt.

Undetermined types (82 fragmentary specimens - No Illustration)
These specimens do not fit into any given categories. For the most part they are too thin for their width and projected lengths. They are so varied in size and shape that separate categories were not defined. Seven (13%) are chalcedony and 69 (87%) are basalt.

Fragmentary Bifaces (68 specimens - No Illustration)
These specimens are too fragmentary to be classified. Eleven (16%) are chalcedony and 56 (84%) are basalt.

BIFACE TIPS by Elizabeth Skinner

INTRODUCTION

Distal ends or tip fragments of bifaces cannot be placed in the types established above because they lack the basal attributes upon which the typology is largely based. There is, however, some variation in the tip fragments that allows for an independent typology to be established. This typology is purely descriptive at this stage and should not be imbued with value other than that of communicating to the reader the general morphology of these bifacial fragments. In describing these artifacts it should be obvious that the width measurements are of little or no value because they represent only the width of the item at the break and not the maximum width of the artifact when it was complete.

DESCRIPTIONS

Type 1.1 (13 specimens)

These distal ends are narrow, projected to be quite long, and exhibit pointed tips and convex edges. They appear to be fragments of leaf-shaped bifaces that are finished tools. Four specimens exhibit retouching along the edges (178-625, 440-504, 178-5411, 178-700). The latter specimen in particular appears to be a projectile point. Cross sections are lenticular or slightly plano-convex and edges are fairly regular. One (8%) specimen is felsite, two (13%) are chalcedony and 10 (77%) are basalt.

Type 1.11 (22 specimens)

This group is very similar to Type 1.1 but is projected to have been longer and to have flared out more. Their bases might have been quite a bit broader than those in Type 1.1 and technologically, they appear to be less finished. Most exhibit percussion flaking only, or bevelled edges resulting from edge grinding. Only three specimens have been pressure-flaked (178-3615, 174-5, 174-439). Cross sections are lenticular or slightly plano-convex and edges are slightly less regular than those in Type 1.1. All 22 specimens are basalt.

Type 1.2 (25 specimens)

These are narrow, triangular in outline, and appear to broaden more rapidly from the tip than types 1.1 or 1.11. Most appear to be longer and probably broader when whole than types 1.1 or 1.11. Only three specimens exhibit pressure flaking and appear to be finished tools, possibly projectile points (178-2053, 180-325, 178-702). In general, these tips exhibit lenticular or slightly plano-convex cross sections and fairly regular edges. Differences in size are primarily due to the amount of the biface present. One (4%) specimen is made of chalcedony, three (12%) are felsite and 21 (84%) are basalt.

Type 1.3 (60 specimens)

This group of biface tips is more leaf-shaped than the previous groups. Tips are pointed but the edges are more convex and flare to indicate that they would get broader towards the base. Their projected lengths would be longer than the previous categories. These may be finished tools because they are quite thin. None exhibit pressure flaking but many do exhibit edge bevelling resulting from edge grinding. Three specimens are lenticular to slightly plano-convex in cross section and exhibit fairly regular edges. One (2%) specimen is chalcedony and 59 (98%) are basalt.

Type 1.4 (52 specimens)

These tips appear to be from medium to large, but quite thin, bifaces. The majority exhibit one nearly straight and one convex edge. Most appear to become much broader towards the base. The tips are pointed to slightly rounded, flaring out immediately below the tip. The cross sections are lenticular to slightly plano-convex and edges are quite regular. None of these appear to exhibit pressure flaking, although a number exhibit edge bevelling that may result from edge grinding. Five (10%) specimens are chalcedony and 47 (90%) are basalt.

Type 1.5 (18 specimens)

This group of tips falls within the medium size range of bifaces. They exhibit rounded tips, parallel edges, lenticular cross sections, and fairly regular edges. Most exhibit percussion flaking with some edge bevelling, but specimens 178-787 and 174-32 exhibit possible pressure

flaking. Two (11%) specimens are chalcedony, 15 (83%) are basalt and one (6%) is made of unidentified macrocrystalline material.

Type 1.6 (50 specimens)

These tips are from medium to medium-large bifaces. They are rounded with convex edges that appear to get broader toward the base. The cross sections are lenticular to plano-convex and edges are fairly regular. None exhibit pressure flaking and percussion flaking is limited primarily to thinning without the edge bevelling. One (2%) specimen is made of felsite and the remaining 49 (98%) are basalt.

Type 1.7 (33 specimens)

This group of tips falls within the medium-sized bifaces. They exhibit nearly rounded tips and convex edges, flaring out near the break more than on Type 1.6 specimens, indicating either that they are widest in the middle or that they would have broad bases. Cross sections are lenticular to slightly plano-convex. None exhibit pressure flaking but some do exhibit edge bevelling. One (3%) is felsite, two (6%) are chalcedony and 20 (61%) are made of basalt.

Type 2.1 (24 specimens)

These biface tips indicate long but quite narrow complete bifaces. They exhibit pointed tips and nearly triangular outlines indicating that their widest portion is near either the base or the center. Cross sections are thick biconvex or thick plano-convex. Edges are irregular and little edge bevelling is seen. One (4%) is made of chalcedony and 23 (96%) are made of basalt.

Type 2.2 (25 specimens)

This group exhibits pointed tips, but less so than Type 2.1 because edges are more convex, flaring out below the tip. Most are asymmetrical with one convex and one straight edge. Percussion flaking is very irregular, sometimes not extending beyond the margin; edges are also very irregular. Cross sections are thick biconvex or thick plano-convex. Two (8%) are made of chalcedony and 23 (92%) are made of basalt.

Type 2.3 (26 specimens)

This group is quite variable in outline, but most exhibit rounded tips and very convex edges. It appears that on many of the bifaces, the widest portion would be near the tip (unless these are actually bases) and they would get narrower below the fracture. It is also possible that the bifaces would be quite short for their width and thickness, and the fracture is at approximately the midpoint. The majority displays a thick biconvex or lenticular cross section. All 26 (100%) specimens are made of basalt.

Type 2.4 (33 specimens)

The majority of these biface tips exhibit rounded tips and convex edges, except the two largest specimens (178-751, 179-6) which exhibit pointed tips. All appear to have the widest portion of the biface near the center. All are quite crude, with unpatterned percussion flaking that usually does not extend past the margin. Most exhibit thick biconvex or lenticular cross section. Two (9%) are made of chalcedony and 21 (91%) are made of basalt.

Type 2.5 (90 specimens)

This group of biface tips is quite variable in outline, but they are nearly all very crudely percussion flaked, exhibit very irregular and asymmetrical edges, and thick asymmetrical cross sections. Two specimens (181-178 and 179-3761) may be bases instead of tips. Specimen 178-810 is very thick, but appears to be more symmetrical than other bifaces. Specimen 178-7607 has a quite thin cross section and appears that it would be a long narrow biface. One (1%) specimen is made of felsite, one (1%) of quartzite, nine (10%) of chalcedony, and 79 (88%) of basalt.

Type 3.0 (23 specimens)

This group of biface tips is quite variable in outline, but they are nearly all very crudely percussion flaked, exhibit very irregular and asymmetrical edges, and thick asymmetrical cross sections. Two specimens (181-178 and 178-3761) may be bases instead of tips. Specimen 178-810 is very thick, but appears to be more symmetrical than the others. Specimen 178-7607

has a quite thin cross section and appears that it would be a long, narrow biface. Four (17%) are made of chalcedony and 19 (83%) are made of basalt.

Type 4.0 (36 specimens)

Most of these biface tips appear to be from long, narrow, thick bifaces, with a few exceptions. Specimens 178-37 and 178-3591 are slightly more finished in appearance and are quite thin; the complete bifaces would have been long and narrow. Both specimens also exhibit some edge bevelling, possibly from platform preparation. Specimen 440-261, although bifacially flaked, exhibits one steeply angled edge with stacked-step fractures, as if it has been used as a uniface. Specimen 178-3573 is nearly complete, exhibits slightly patterned flaking, and may be a base. Four (11%) are made of chalcedony and 32 (89%) are made of basalt.

Type 5.0 (13 specimens)

This group of biface tips is untypeable; all are broken along one lateral edge or are very small fragments. All 13 (100%) are made of basalt.

Type 6.0 (8 specimens)

These bifaces are nearly complete, lacking the basal portion only. Unlike most of the other biface tips, the widest portion is not at the fracture. When complete, these bifaces would be quite short and broad, with the greatest width near the proximal end and quite convex edges. One (12.5%) is made of felsite, two (25%) are of chalcedony and five (62.5%) are made of basalt.

Unclassified Tips (25 specimens)

These were too incomplete to classify. Five (20%) of these specimens are made of chalcedony and 20 (80%) are made of basalt.

Biface Midsections

The 185 midsections are grouped into three categories, primarily on the basis of width and thickness, but also to some degree on flaking pattern because the range of widths and thicknesses do overlap between categories.

CATEGORIES

Type 1 (43 specimens)

The midsections in this group are generally narrow and quite thin with straight to nearly straight edges. Those that are thicker in cross section generally exhibit very regular, almost ground edges. Most appear to be more finished than the midsections in the other categories. Six (14%) are chalcedony, one (2%) is quartz and 36 (84%) are basalt.

Type 2 (106 specimens)

These midsections fall within the medium range of bifaces and vary widely in outline and cross section. Edges are generally fairly regular, but the percussion flaking is nonpatterned. This group appears to be less finished forms than Type 1 midsections. Eight (8%) are chalcedony, one (1%) is rhyolite and 97 (91%) are basalt.

Type 3 (36 specimens)

These midsections are quite large and crude. In many cases the percussion flaking does not travel to or across the midline. The outlines and cross sections vary among these specimens, although most of them are thick and biconvex or thick and irregular, and biconvex. One (3%) is chalcedony, two (5%) are rhyolite and 33 (92%) are basalt.

Miscellaneous Biface Fragments

A number of items that are actually flakes were separated out because of their potential information about certain tool classes. The first of these are "outrepasse" (Tixier 1963) or

overshot flakes, which most often result when a flake is produced from force that travels from one margin, across the face of the biface (or uniface or core) and to the other margin, removing a portion of the opposite margin. In many cases, the portion identified as the overshot flake is actually the core portion; a flake is removed with a hinge termination that leaves the biface with most of the face exhibiting negative flake scars but evidence of the biface on one end (see Callahan 1979:74). These flakes indicate rejuvenation and potentially contain important use-wear evidence.

The second group consists of flakes whose platforms are a biface or uniface edge, indicating rejuvenation of a tool. These flakes potentially can provide use-wear information.

The third category contains edge fragments of bifaces that removed a significant portion of the biface. These pieces result from various types of force, and include overshot and pseudo-overshot flakes (Callahan 1979: Figure 6l c-g, Figure 62 b and d), and a type of end shock resulting in a distinctive triangular section (Callahan 1979: Figure 63 d), as well as miscellaneous fragments. The fracture faces on these pieces exhibit fracture planes as opposed to flake characteristics.

Bifacially Worked Flakes

These are flakes that exhibit some type of edge attrition, possibly percussion flaking, use wear or post depositional damage. Only four specimens can be interpreted. Specimens 178-5168 and 178-4645 exhibit bifacial marginal damage that could result from chopping use. Specimen 178-2308 exhibits one thin concave edge with unifacial damage, possibly indicating sloping. Specimen 178-4110, the only non-basalt flake in this group, is the core portion of an overshot flake on a biface (see Callahan 1979: Figure 59 d).

Amorphous Fragments

This group consists of 87 bifacially flaked fragments that are too incomplete to determine the type of biface or to identify the portion of the biface from which the fragments were derived. Seventy-three (84%) of the specimens are made of basalt and 14 (16%) of chalcedony.

CORES by Elizabeth Skinner

Type 1: Bipolar Cores (32 specimens)

Bipolar cores result from bipolar flaking, which is the technique of resting the core on an anvil and striking it with a percussor. If the force from the anvil and from the percussor are approximately opposite in direction where the core is resting on the anvil, the flakes will run the full length of the core. If the force from the percussor is not opposite the portion of the core resting on the anvil, the flakes may not travel the full length of the core. This technique is generally used for two purposes: (1) when small rounded cobbles are reduced, or when a core has become too small to be reduced further by free-hand percussion; and (2) to produce particular types of flakes. The use of an anvil allows the force to penetrate from both directions and the resulting flake is flat with a sheared (flat) bulb of force (Flenniken 1980). Two (6%) of these cores are felsite, 29 (91%) are chalcedony and one (3%) is an unidentified macrocrystalline material.

Type 2: Bifacial Cores (88 specimens)

The biface core is similar in appearance to a Stage I biface, and in fact some of the bifaces described under complete bifaces are little different than some cores in this group. A bifacial core is often produced when flaking tabular material, removing flakes from lateral edges in an alternate flaking pattern Specimen 180-619 appears to be a test block; only two or three flakes have been removed from one end of a tabular cobble. One (1%) specimen is rhyolite, 33 (38%) are chalcedony and 54 (61%) are basalt.

Type 3: Platform Cores (34 specimens)

The traditional platform core is a "refined type of unidirectional core ordinarily used to obtain typological blades. Such forms are prepared and show evidence of flake removal in a highly controlled fashion around the periphery of the striking platform" (Eckhardt and Hatley 1982: 60). These are also known as prismatic cores. Platform cores at the Nelson Wash sites (and, in fact, throughout the Mojave Desert), are not particularly refined or specialized. They do exhibit a flat platform from which flakes were removed in a unidirectional pattern, but the shape

is usually fortuitous, as is the occasional removal of a blade-like flake. The resulting core, more or less expended, is generally prismatic in shape. One (3%) specimen is quartzite, 15 (44%) are basalt and 18 (53%) are chalcedony.

Type 4: Multidirectional Cores (15 specimens)

A multidirectional core is one on which flakes were removed from more than two directions, usually any available surface being used as a platform. All of the specimens exhibit cortex. Three are quite large, but appear to be of good quality material. Three (20%) are basalt and 12 (80%) are chalcedony.

Type 5: Split Cobble Cores (10 specimens)

Split cobble cores are the core portion of a split cobble, with no subsequent alteration after the initial split. Two (20%) are chalcedony and eight (80%) are basalt.

Type 6: Other/Undetermined (10 specimens)

These are generally fragments, small and chunky, with no diagnostic shape and incomplete flake scars. They cannot be placed into a more formal type. Four (40%) specimens are basalt and six (60%) are chalcedony.

Type 7: Possible Bipolar Cores (96 specimens)

This group of cores is generally larger than the Type 1 cores. They do not exhibit the more traditional characteristics of bipolar cores but are interpreted as being most likely bipolar cores. The general pattern reveals the use of a natural cobble surface, usually with cortex, as the platform. The opposite end exhibits a sharp sinuous edge with crushing. Two specimens (178-4308 and 178-3551) may have been used as hammerstones. Seven (7%) are made of basalt, one (1%) of rhyolite and 88 (92%) of chalcedony.

Type 8: Uniface Cores (9 specimens)

These cores are made on tabular or rounded cobbles and have been flaked on only one face; the other face on all specimens is covered with cortex. Flake scars can be from one, two, or many directions. One (11%) specimen is chalcedony and eight (89%) are basalt.

Type 9: Bidirectional Opposing (2 specimens)
Cores of this type have been flaked from two directions, but from opposing ends and can be unifacial of bifacial. These two specimens are bifacial. One is basalt and one is chalcedony.

UNIFACE TOOLS by Claude N. Warren

Type 1.0: Large Keeled End and Side Scrapers (12 specimens - Plate 4-44)
Ovoid to rectangular in outline, plano-convex to triangular in cross-section, these scrapers are made on thick flakes by steep angle unifacial flaking along one or both long edges. Nine of the ten specimens also exhibit steep angle flaking on one or both ends. Range and mean uniface measurements by type are presented in Table 4-3.

Table 4-3: Uniface Measurements by Type.

Type	Length			Width			Thickness		
	Range	Mean	N	Range	Mean	N	Range	Mean	N
1.0	6.44-10.48	8.28	6	3.87-5.64	4.92	6	2.03-3.27	2.83	6
2.1	4.39-8.40	5.89	13	3.15-7.04	4.70	13	1.34-2.68	2.08	13
2.2	4.03-10.33	5.85	38	3.38-7.60	5.03	37	1.59-4.14	2.41	37
3.0	2.90-4.65	3.77	18	2.00-3.30	2.79	18	1.13-2.54	1.72	18
4.0	5.26-10.36	6.98	16	4.04-7.44	5.33	15	1.80-3.86	2.79	15
5.1	3.53-4.49	4.11	5	1.77-3.18	2.70	6	0.76-1.30	0.94	6
5.2	3.84-6.66	5.34	5	3.56-4.58	4.15	5	0.70-1.35	1.13	5
5.3	3.65-6.25	4.99	5	3.17-3.40	4.03	5	1.25-2.01	1.67	5
5.4	4.70-5.65	5.11	4	2.81-3.23	3.03	4	1.30-1.72	1.57	4
5.5	4.60-6.30	5.43	7	3.17-3.91	2.57	7	1.58-2.09	1.77	7
5.6	3.72-7.48	5.32	7	3.71-5.22	4.56	7	1.11-1.79	1.47	7
6.0	5.65-8.15	6.51	5	2.90-3.57	3.36	5	1.12-1.48	1.30	5
7.1	4.57-10.02	6.26	15	2.60-6.00	3.96	15	1.04-1.92	1.44	15
7.2	5.22-8.65	6.46	16	2.54-4.90	3.99	16	1.17-2.17	1.68	16
7.3	3.88-5.80	5.01	17	2.28-4.24	3.22	17	0.69-1.37	1.10	17
8.1	3.89-6.64	5.19	17	2.42-4.77	3.39	17	0.68-2.33	1.49	17
8.2	4.28-4.65	4.51	3	2.91-3.22	3.05	3	1.07-1.34	1.19	3
9.0	4.14-6.80	5.66	12	3.06-5.62	4.52	11	0.79-1.57	1.19	11
10.0	7.82	----	1	5.71	----	1	-----	2.36	1
11.0	7.95-10.00	8.73	3	5.73-7.50	6.60	3	1.48-2.87	2.37	3
12.1	4.40-5.91	5.16	2	2.93-3.62	3.28	2	0.50-0.82	0.66	2
12.2	4.00-9.43	6.83	6	3.14-6.32	5.02	6	1.05-1.90	1.37	6

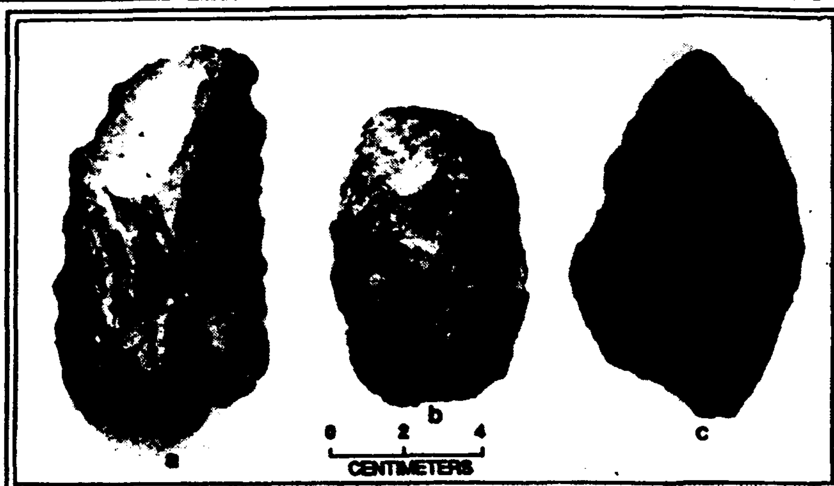


PLATE 4-44. TYPE 1.0 LARGE KEELED END AND SIDE SCRAPERS

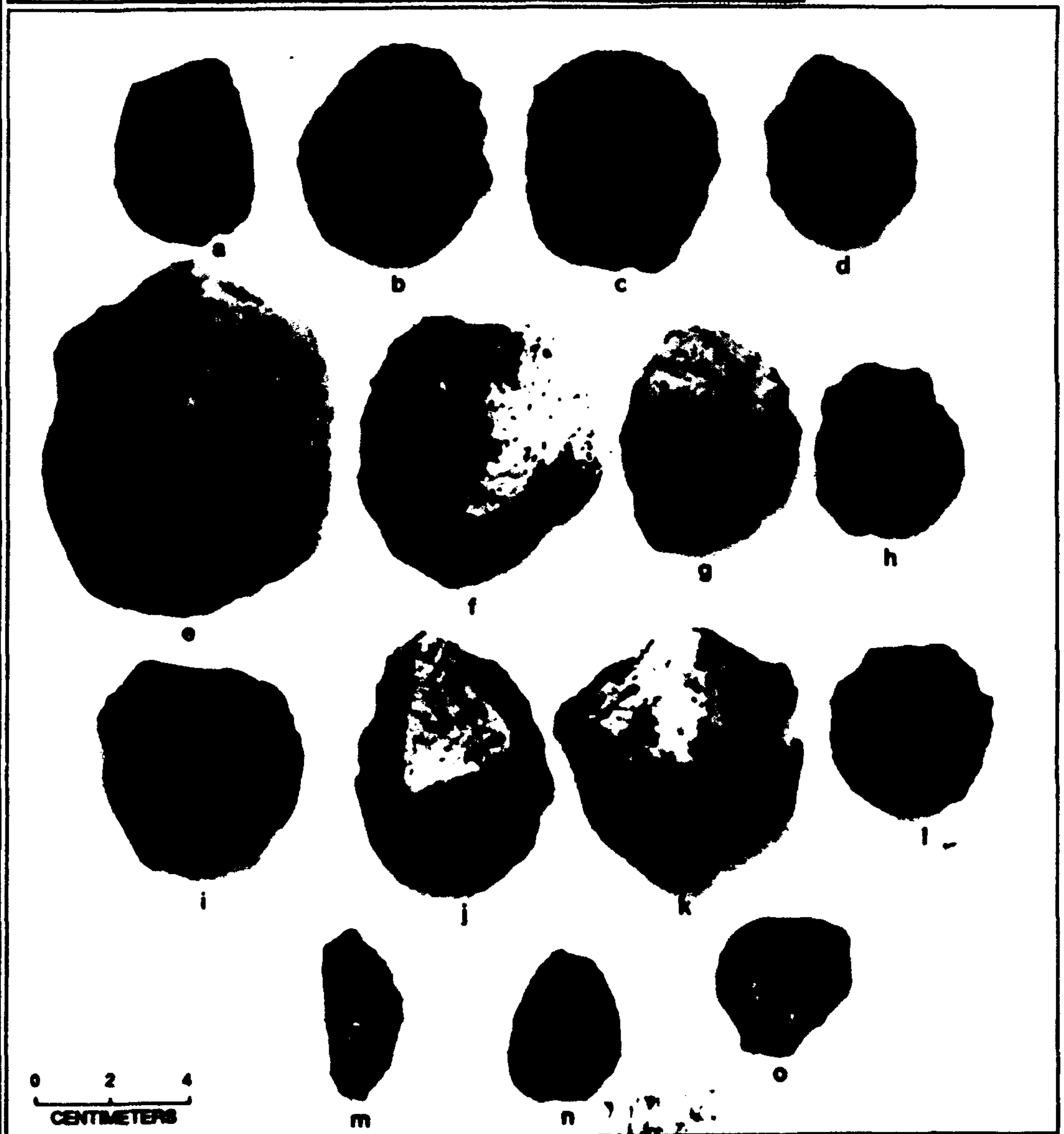


PLATE 4-45. TYPE 2.0 DOMED SCRAPERS. a-d: Type 2.1; e-l: Type 2.2; m-o: Type 3.0

Table 4-3: Continued.

Type	Length Range	Length Mean	Length N	Width Range	Width Mean	Width N	Thickness Range	Thickness Mean	Thickness N
13.1	4.69-6.55	5.62	2	4.12-4.98	4.55	2	0.91-1.45	1.18	2
13.2	4.45-10.17	6.04	11	2.39-6.03	4.19	11	0.90-2.75	1.50	11
13.3	4.88-7.61	6.13	4	2.67-3.85	3.47	4	0.84-1.50	1.06	4
13.4	2.66-7.86	5.47	11	2.51-7.06	4.59	11	0.51-1.88	1.24	10
13.5	3.87-8.55	5.45	12	3.05-6.24	4.39	12	0.80-2.77	1.54	12
13.6	3.65-6.83	5.29	21	2.00-5.50	3.55	21	0.51-2.34	1.28	21
14.1	5.68-8.73	7.20	4	3.82-6.35	4.97	4	1.20-1.91	1.59	4
14.2	2.49-8.70	5.01	32	1.56-6.54	3.83	32	0.34-2.20	1.07	32
14.3	1.80-8.10	4.41	43	1.30-5.76	3.24	43	0.37-2.24	1.24	42
15.1	4.19	----	1	3.09	----	1	-----	0.63	1
15.2	5.43-5.55	5.49	2	3.02-3.83	3.43	2	1.15-1.20	1.18	2
15.3	3.97-4.99	4.59	3	2.61-4.09	3.27	3	0.94-1.28	1.08	3
15.4	3.40	----	1	2.67	----	1	-----	0.50	1
16.1	1.91-6.54	4.22	8	1.64-5.31	3.07	8	0.43-1.47	1.00	8
16.2	3.06-4.18	3.83	7	2.27-3.81	3.10	7	0.71-1.52	0.97	7
16.3	3.92-5.34	4.67	4	3.13-4.15	3.64	5	1.10-1.96	1.63	4
17.1	5.50-9.20	6.87	13	2.87-5.91	4.27	13	1.05-2.01	1.38	13
18.0	3.62-7.24	5.45	18	3.28-5.92	4.49	17	0.92-2.08	1.41	17
19.0	4.70	----	1	2.72	----	1	-----	1.13	1
20.0	5.85	----	1	4.30	----	1	-----	2.34	1
21.0	4.54-6.02	5.23	5	2.80-4.58	3.53	5	1.39-2.12	1.74	5
22.0	4.24	----	1	1.93	----	1	-----	0.55	1
23.0	6.46	----	1	5.18	----	1	-----	1.25	1
24.0	7.92	----	1	6.80	----	1	-----	2.61	1

The outline of these scrapers is modified by flake removal, although the gross form is largely determined by the shape of the original flake. Flake scars extend from the edges to the keel or apex of the dorsal face on nine of the 12 specimens. This type is similar to Amsden's (1937:61) elongate keeled scrapers; however, these large keeled scrapers correspond only to the large end of the size range described by Amsden.

Type 2.0: Domed Scrapers (58 specimens - Plate 4-45, a-l)

Ovoid in outline and plano-convex to triangular in cross section, these tools are made on thick flakes and rarely on cores, by steep angle unifacial removal of flakes from about one-third of the edge to the entire periphery. Flake scars extend from edges well up onto the domed convex face, often removing all former surfaces of the flake. The major working edge, when a single edge can be identified as such, may be on the long edge or the narrow end of the oval form. When the striking platform or bulb of percussion is present, the major working edge may be either an adjacent or opposing edge. The size range of the class is large, but represents a continuum and the class cannot be neatly subdivided on the basis of size. The size of each specimen is dependent on two factors: (1) size of the flake or core upon which it was made; and (2) the degree to which maintenance by resharpening the working edges has reduced the size. The reworking of the edges during maintenance of these scrapers also probably has changed the shapes from their initial form. This may result from one edge being more heavily used and consequently resharpened more often than other edges, thus reducing one dimension more than others.

The category "Dome Scrapers" includes both round scrapers and keeled round scrapers as described by Amsden (1937:61-63). The differences between Amden's round and keeled round scrapers are both subtle and subjective:

> Round scrapers differ from the keeled in having a somewhat consciously rounded form, with the scraping edges equally developed and unifacially slanted around the whole periphery; in being rounded off rather than peaked or keeled at the top, and sometimes having a broad flake-channel across the very top to serve as a thumb-hold.
> ...I admit that some of them come very near to being flattish round keeled scrapers (Amsden 1937:61).

Most of the scrapers of this category are ovoid to nearly circular in outline, but whether or not one is more "consciously round" than another cannot be determined. Some exhibit more even edges than others as a result of more intensive flaking and these also tend to exhibit thinner

cross-sections, lacking the peak or keel. They do not appear to be any more circular in outline than other domed scrapers, however, and they may exhibit flaking on as little as circa one-quarter of the periphery. On the basis of rather tenuous criteria, Domed Scrapers are divided into two variants:

Type 2.1 (18 specimens: equates more closely with Amsden's "round scrapers"; Plate 4-45, a-d) Exhibit even edges with intensive well controlled flaking and relatively thin plano-convex cross sections.

Type 2.2 (50 specimens; equates more closely with Amsden's "keeled round scrapers"; Plate 4-45, e-l) Exhibit more sinuous edges, with less well controlled flaking and a triangular or thick plano-convex cross section.

Type 3 Mini-Domed Scraper (19 specimens - Plate 4-45; m-o)
Small thick flakes and cores unifacially flaked around circa one-quarter to entire periphery producing an oval, circular or irregular outline and a thick triangular, plano-convex or irregular cross section. Flaked edges are most often convex, but may be a composite of convex and straight and/or concave forms. Edges are flaked at a steep angle and exhibit no consistent relationship to the position of the striking platform and bulb of percussion. These Miniature Domed Scrapers also exhibit the variants identified for the Domed Scrapers:

Type 3.1 (4 specimens) Exhibit even edges, well controlled flaking and relatively thin plano-convex cross section.

Type 3.2 (15 specimens) Exhibit more sinuous edges, less well controlled flaking and triangular, thick plano-convex or irregular cross sections.

Type 4: Irregular Domed Scrapers (12 specimens)
These artifacts are made on thick flakes and small cores and are irregular in both outline and cross section. Steep angle unifacial flaking occurs around one-sixth to one-half of the periphery. Flaked edge is worked to a convex shape and flakes extend to near the apex of the scrapers.

The basal surface is usually a single flake scar, but irregular bases do occur. Dorsal surfaces are irregular and in seven of the 12 specimens the original cortex is present.

Type 5.0: End Scrapers (39 specimens - Plate 4-46)
Scrapers of this class are elongate oval, tear-drop shaped, or triangular in outline and plano-convex to triangular in cross section. One end is steeply unifacially flaked to form a convex or straight edge. Lateral edges are usually, but not always, unifacially flaked, and occasionally exhibit limited bifacial flaking. The remaining end is usually left unworked. There is considerable variation in this class, reflecting selection of original flake and degree of modification. The variants are as follows:

Type 5.1 (6 specimens - Plate 4-46, a-b) Made on blades or end-struck flakes with triangular cross sections and trapezoidal outlines. Striking platform and/or bulb of percussion is located at one end. The opposite end is steeply unifacially worked forming a convex leading edge. Lateral edges may or may not be modified by limited unifacial retouch.

Type 5.2 (9 specimens - Plate 4-46, c-e) Made on end-struck flakes with triangular to plano-convex cross sections and ovoid to tear-drop outlines. Striking platform and/or bulb of percussion is located at one end. Opposite end unifacially worked, forming steep leading edge. Four of the nine specimens exhibit unifacial flaking along lateral edges, and one of these is also flaked on the trailing edge except for a portion of the striking platform.

Type 5.3 (6 specimens - Plate 4-46, f-h) Made on thick end-struck flakes with broad tear-drop outlines and thick plano-convex cross sections. Striking platform and/or bulb of percussion is located at narrow end on five of six specimens. In one case (178-5413) the bulb is located on one edge. The broad end is unifacially percussion flaked and pressure retouched at a steep angle. One or both lateral edges are unifacially flaked. This variant is thickest at the broad leading edge and tapers gently to the trailing base.

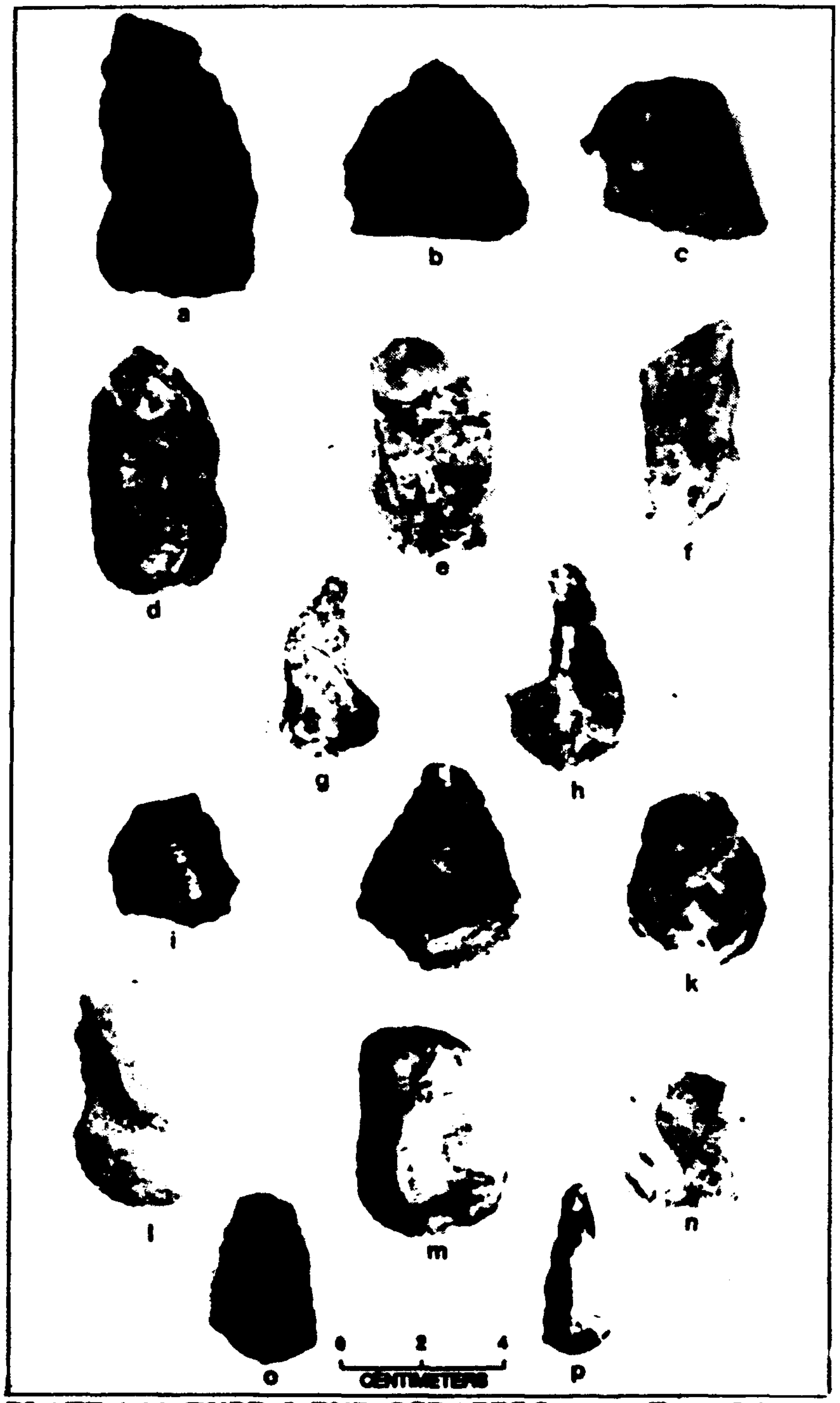


PLATE 4-46. TYPE 5 END SCRAPERS. a,b: Type 5.1; c-e: Type 5.2; f-h: Type 5.3; i,j: Type 5.4; k-m: Type 5.5; n-p: Type 5.6

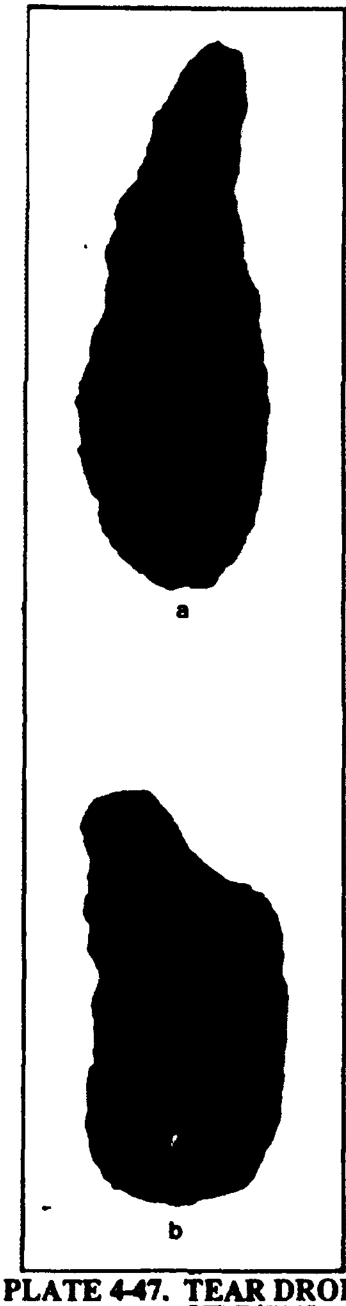


PLATE 4-47. TEAR DROP SIDE/END SCRAPERS.

Type 5.4 (4 specimens - Plate 4-46, i-j) Elongate tear-drop shaped in outline with thick plano-convex cross sections. Bulb of percussion is located at the narrow end of two specimens (178-5490, 178-2500), but is not present on the other two. The broad end is steeply unifacially flaked. Lateral edges are also unifacially flaked but less intensely. The narrow one-third of one specimen (174-18) exhibits bifacial flaking. These scrapers are thickest at the broad end and taper gently to the trailing base.

Type 5.5 (6 specimens - Plate 4-46, k-m) Ovoid in outline and thick plano-convex to triangular in cross section. The most concentrated unifacial flaking occurs on one end, producing a steep, angled convex edge. Lateral edges are unifacially flaked; the remaining end is unifacially flaked on three specimens (178-7841, 178-4546, 440-397); and the bulb of percussion is present on the unmodified ends of two specimens (178-18, 178-4470). On the remaining specimen, the end is broken. This variant corresponds most closely to the small specimens included in Amsden's (1937:61) elongate keeled scrapers, and to his end and side scrapers (Amsden 1937:63-64). Flaking on lateral edges of variant 5 extends from the edge to a medial line (the keel) on five of the six specimens. The exception exhibits an inclusion in the material and an irregular fracture that prevents flakes from extending to the medial line.

Type 5.6 (8 specimens - Plate 4-46, n-p) Triangular to rectangular in outline, plano-convex in cross section. Unlike other end scrapers, the leading edge is straight rather than convex. The leading edge exhibits steep unifacial flaking. The lateral edges are unifacially retouched on four specimens. One of these (180-438) is thinner than other specimens and unifacially retouched around the whole periphery.

Type 6: Tear Drop Side/End Scrapers (7 specimens - Plate 4-47)
Artifacts of this category are tear-drop shaped in outline and thin plano-convex in cross section. The outline is formed primarily by extensive unifacial flaking about the periphery. The only unworked edges (excluding broken specimens 180-277 and 178-6281) are where platforms are present on one lateral edge of two specimens (178-4056 and 180-129), a tiny remnant of a platform on the broad end of a third specimen (440-116), and minimal retouch on the broad end

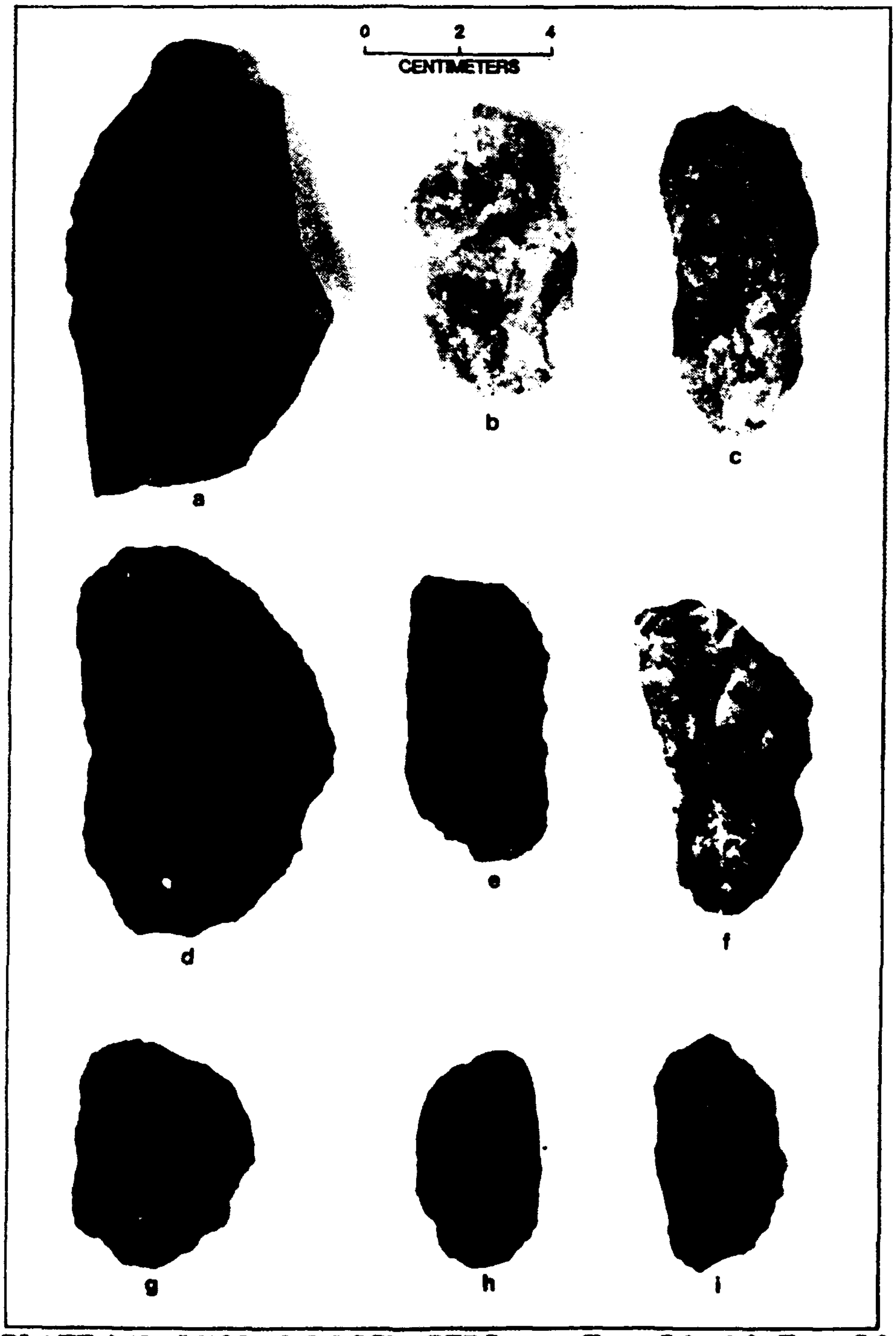


PLATE 4-48. OVOID SIDE SCRAPERS. a-c: Type 7.1; d-f: Type 7.2; g-i: Type 7.3

of specimen 180-129. This class differs from end scrapers of similar form in exhibiting low angle flaking on the broad convex end, steep heavy flaking on one lateral edge, and a thin cross section. One specimen (174-10) exhibits a small graver spike (typical of spiked gravers) at each end.

Type 7: Ovoid Side Scrapers (49 specimens - Plate 4-48)
Elongate oval or rectangular in outline and plano-convex in cross section, unifacially flaked on one or both lateral edges. This class is variable, reflecting differences in edge angle, extent of flaking on the edge (e.g. one or two lateral edges), and material. This class is one of the most numerous and is apparently represented by a large number of fragments. The variants listed below are based on size and extent of flaking along the edges:

Type 7.1 (19 specimens - Plate 4-48, a-c) Made on elongate flakes, either end or side struck. with unifacial flaking occurring on both lateral edges and at least one end. Flakes extend from lateral edges to medial line except on a few specimens made on flat basalt flakes (181-367, 178-3976, 178-4508). This variant is characterized by an elongate oval outline with rounded ends, and a relatively flat plano-convex cross section.

Type 7.2 (13 specimens - Plate 4-48, d-f) Made on elongate flakes, either side or end struck, with unifacial flaking limited to one or both lateral edges. The outline is variable, ranging from ovoid to rectangular and the cross section varies from plano-convex to triangular. Flaking on lateral edges is characteristically limited to margins of the artifact.

Type 7.3 (17 specimens - Plate 4-48, g-i) Elongate oval to nearly circular in outline, flat plano-convex in cross section. Made on side struck (14 specimens) or end struck (three specimens) flakes. Unifacially flaked around one-half to entire periphery with one lateral edge most heavily worked. Opposite edge often (10 specimens) exhibits a few thinning flakes removed from the planar face. This variant is small and thinner than other variants.

Type 8: Pointed Scrapers (24 specimens - Plate 4-49)

"Pointed Scrapers" is a variable class of artifacts made on flakes or broken bifaces. The unifying characteristic is the unifacially flaked, pointed end. There are two variants:

Type 8.1 (22 specimens - Plate 4-49, a-c) A class of elongate scrapers, triangular in outline and plano-convex to triangular in cross section. The two long edges meet at an acute angle and are unifacially flaked to produce a relatively sharp point. The base is usually unworked and may exhibit a striking platform or an irregular edge. There is considerable variation in the thickness of these scrapers and this thickness is reflected in the angle of the flaked edges.

Type 8.2 (2 specimens - Plate 4-49, d-e) Made on basal fragments of leaf-shaped bifaces. A broken edge has been reworked to form a pointed projection. The final stage of reworking was steep angled uniface flaking along the margins of the pointed projection, giving it a thick-steep plano-convex cross section. The basal portion of these artifacts are convex in outline and bifacially flaked to form a lenticular cross section.

Type 9: Thin Tabular Scrapers (16 specimens - Plate 4-50, a-c)
Specimens of this type are irregular oval to subrectangular in outline and irregular to plano-convex in cross section. They are made on flakes by unifacial flaking of one or more edges to form a straight or convex working edge. Flaking is limited to the margin, but extensive enough to have modified the shape of the flake. Twelve specimens have convex working edges, three have straight working edges, and one has a combination of one concave and two straight edges.

Type 10.1: Thick Tabular Scrapers (2 specimens - Plate 4-50, d-e)
These specimens are made on thick tabular flakes by unifacial flaking along two or more adjacent edges, producing a U-shaped or squared working edge. The two specimens complete enough to classify exhibit U-shaped working edges and an irregular unworked "butt" forming an irregular ovoid outline. The cross sections are rhomboidal with flat ventral and dorsal faces. It appears that scrapers of this class were frequently broken, resulting in a relatively large

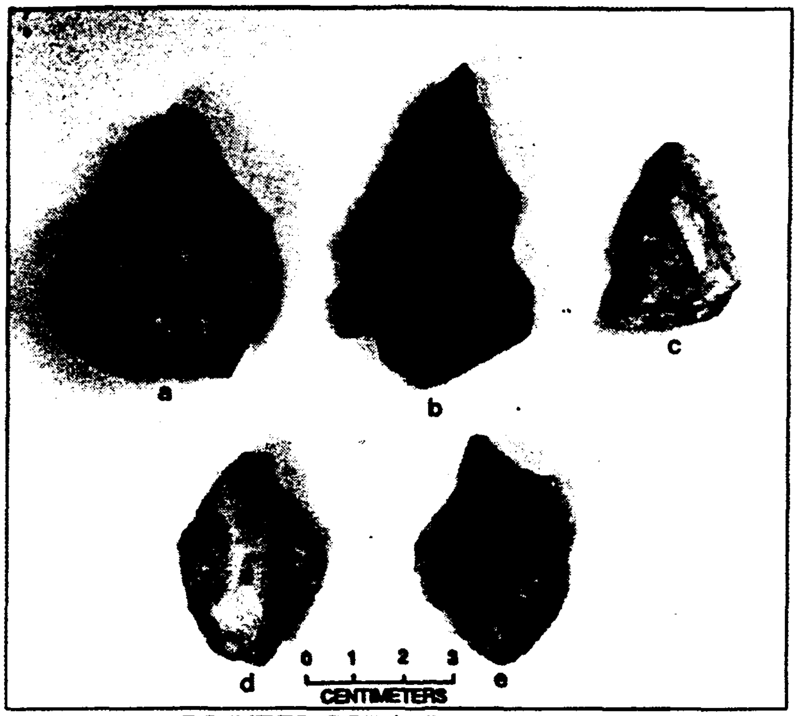


PLATE 4-49. POINTED SCRAPERS.
a-c: Type 8.1; d,e: Type 8.2

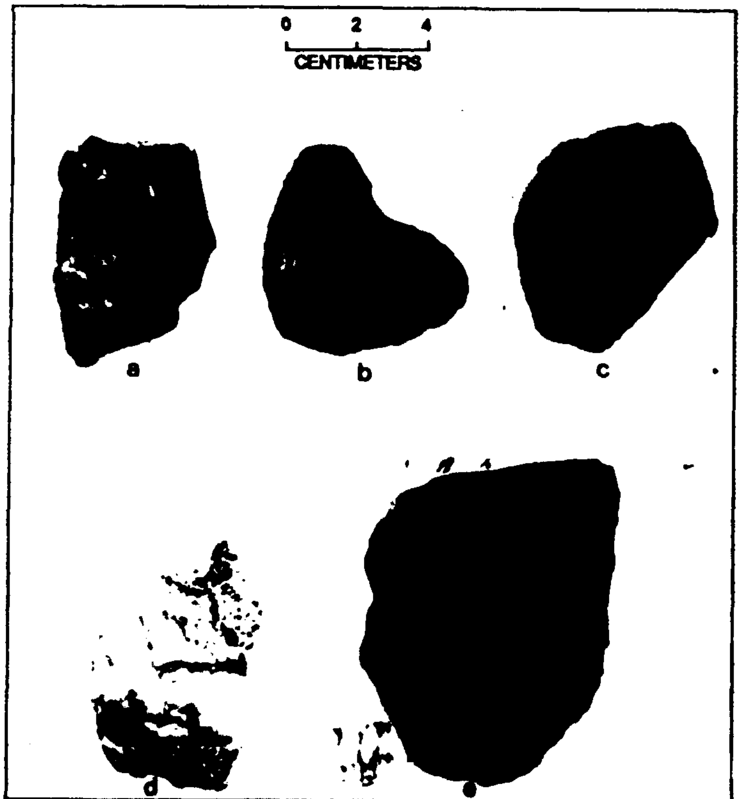


PLATE 4-50. TABULAR SCRAPERS.
a-c: Type 9.0 Thin Tabular Scrapers; d,e: Type 10.1 Thick Tabular Scrapers

number of fragments and only two "complete" specimens (see Fragmentary Thick Tabular Scrapers).

Type 10.2: Fragmentary Thick Tabular Scrapers (25 specimens)

These are fragments that exhibit flat dorsal and ventral faces and unifacial flaking on unbroken edges. They appear to be fragments of thick tabular scrapers, exhibiting similar dimensions and the characteristic rhomboidal cross section.

Type 11: Large Rectangular Side Scrapers (5 specimens - Plate 4-51)

These scrapers are made on large rectangular flakes and are rectangular in outline, roughly plano-convex to irregular in cross section. Unifacially percussion flaked along one or two straight edges followed by finer secondary flaking. Worked edges are straight and flaked at a steep angle. Two specimens are large flat flakes and flaking is limited only to the edges. Remaining scrapers are somewhat domed or keeled with flakes extending well up on the dorsal face.

Type 12: Flake Knives (18 specimens - Plate 4-52)

Flake knives are made on end struck and side struck flakes and are usually thin with very sharp low angle edges that exhibit low angle unifacial flaking. Flaking occurs along any available edge, but exhibits a smooth, even, curved or straight edge. Two variants of these knives are made on two types of flakes:

Type 12.1: Elongate Flake Knives (4 specimens - Plate 4-52, a-b) Made on elongate end struck flakes or blades with two long edges available for use; usually exhibit two cutting edges, one on each edge of the blade.

Type 12.2: Ovoid Flake Knives (14 specimens - Plate 4-52, c-d) Made on ovoid to triangular side struck flakes with one or two available edges. This variant exhibits one or two "cutting

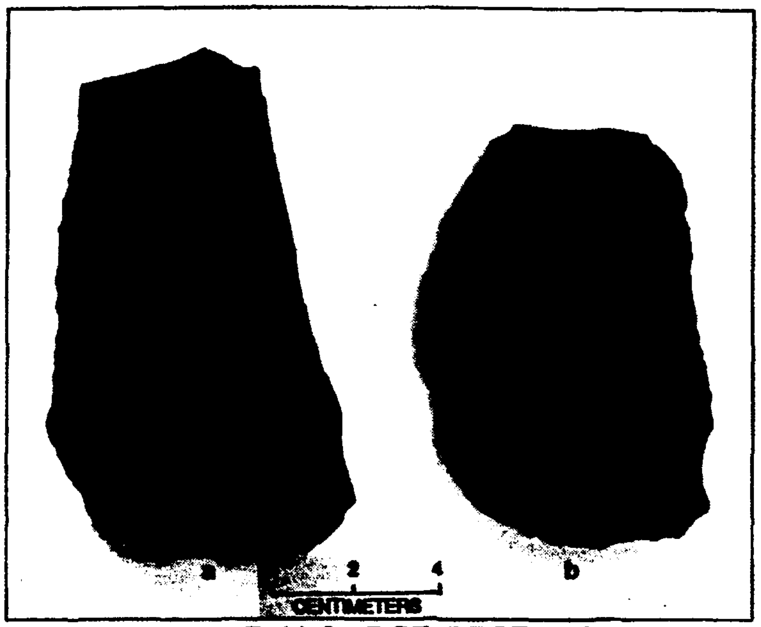


PLATE 4-51. TYPE 11 LARGE RECTANGULAR SIDE SCRAPERS

PLATE 4-52. TYPE 12 FLAKE KNIVES.
a,b: Elongate Flake Knives;
c,d: Ovoid Flake Knives

edges", but the non-cutting edge is thick, may retain the striking platform or cortex, and forms a blunt edge similar to a backed blade.

Type 13: Irregular Flake Scrapers (112 specimens - No Illustration)

These are flakes that have been either modified by use or have had limited unifacial flaking on one or more edges. They are generally irregular in form with one or more retouched edges. Worked or used edges are convex, straight, or concave, and may occur in different combinations on a single flake. Flake scrapers have been subdivided on the basis of material (basalt or cryptocrystalline quartz). Each of these categories is further subdivided by general dimensions of the flake: elongate and discoidal. The basalt flakes are further subdivided on the criterion of presence or absence of cortex on the flake. Six variants are recognized here:

Type 13.1 (8 specimens) Made on basalt primary flakes (cortex present); discoidal in shape.

Type 13.2 (12 specimens) Made on basalt primary flakes (cortex present); elongate in form.

Type 13.3 (32 specimens) Made on basalt secondary flakes (cortex absent); discoidal in shape.

Type 13.4 (7 specimens) Made on basalt secondary flakes; elongate in form.

Type 13.5 (19 specimens) Made on cryptocrystalline quartz secondary flake; discoidal in shape.

Type 13.6 (34 specimens) Made on cryptocrystalline quartz secondary flake; elongate in form.

The elongate flakes may be either end struck or side struck and the worked edge may be either end or lateral edge. The discoidal flakes exhibit wear or secondary flaking on one or more available edges. As the name implies there is little or no patterning in this category.

Type 14: Miscellaneous Uniface Fragments (209 specimens)

These are fragments of unifacially worked flakes that are too incomplete to identify as to category. They are divided into three variants on the bases of material and flake type.

Type 14.1 (36 specimens) Made on primary basalt flakes.

Type 14.2 (93 specimens) Made on secondary basalt flakes.

Type 14.3 (80 specimens) Made on secondary cryptocrystalline quartz flakes.

Type 15: Concave Scrapers (11 specimens - Plate 4-53)
Concave scrapers are elongate rectangular or rhomboidal in outline and plano-convex in cross section. One or more edges have a pronounced concave form similar to a spoke shave. There are four variants:

Type 15.1 (3 specimens - Plate 4-53, a) Elongate rhomboidal in outline with broad concave to convex bases, two long concave edges and narrow, irregular and unmodified apices. Only the long concave edges are consistently unifacially flaked. The base may or may not be flaked.

Type 15.2 (2 specimens - Plate 4-53,b) Crescent-shaped in outline with blunt rounded or squared off ends, plano-convex in cross section, with steep angled unifacial flaking occurring on both the concave and convex edges. One specimen (Plate 4-53,b) also exhibits two graver spikes, one near the center of the convex edge and a second at the interior corner of the squared end.

Type 15.3 (3 specimens - Plate 4-53, c) Made on elongate flakes with one long edge unifacially flaked to form a concave edge.

Type 15.4 (3 specimens - Plate 4-53, d) Made on elongate flakes with the wider end unifacially worked to form a concave edge.

Type 16: Spiked Gravers (21 specimens - No Illustration)

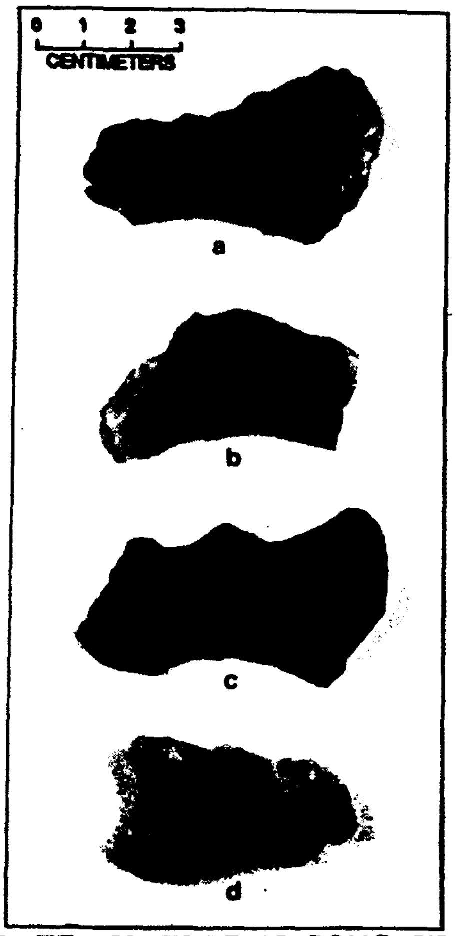


PLATE 4-53. TYPE 15 CONCAVE SCRAPERS. a: Type 15.1; b: Type 15.2; c: Type 15.3; d: Type 15.4

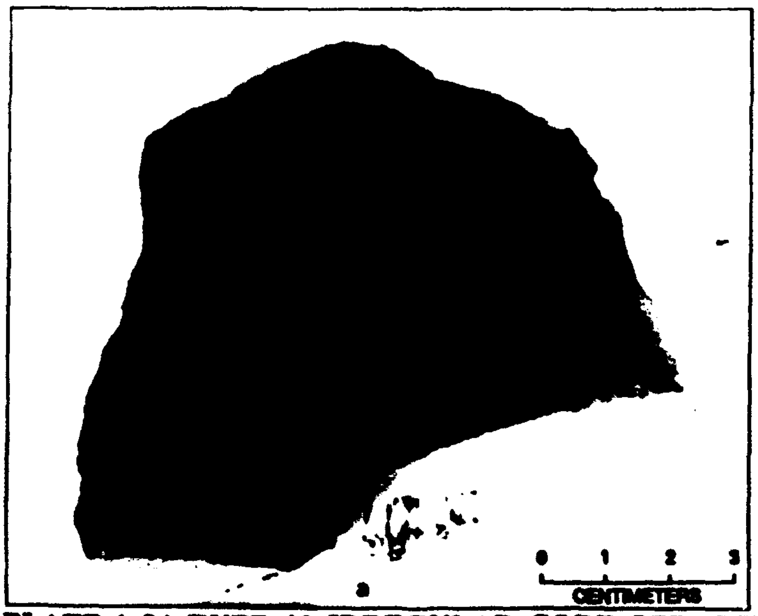


PLATE 4-54. TYPE 19 IRREGULAR CORE SCRAPER

Spiked gravers ("scraper gravers" of Amsden [1937]) take a variety of forms, but all exhibit one or more small unifacially worked "engraving" spikes. These small engraving spikes occur on the edges of worked flakes, flake scrapers, small domed scrapers and occasionally on reworked broken tools. The number of spikes on a single artifact may vary from one to six.

Type 16.1 (8 specimens). Exhibit single spikes; made on flakes and flake scrapers. Spikes occur on relatively straight edges where they are produced by unifacial pressure flaking, or on naturally sharp corners or projections where they are modified by unifacial pressure retouch.

Type 16.2 (8 specimens). Exhibit multiple engraver spikes; made on flakes and flake scrapers. Spikes are produced by unifacial pressure flaking on natural sharp corners or projections, or by shaping on a curved edge.

Type 16.3 (5 specimens). Exhibit single engraver spikes; made on small domed scrapers. Spikes are created by resharpening a corner or transverse break (440-15), or by unifacially reducing an edge to produce a spike (178-3692, 174-191, 440-499, 178-3427). One specimen (178-4993) is made by unifacially removing flakes from opposite faces on the opposing edge of the spike except at the tip, where flakes are removed from only one face producing a unifacial spike.

Type 17: U-shaped Fragments (38 specimens - No Illustration)
U-shaped scraper fragments, apparently parts of elongate oval scrapers. These include five specimens with a bulb of percussion at one end and a broken opposite end. One or both lateral edges exhibit secondary flaking. Thirty-two specimens appear to be end fragments without the bulb of percussion and exhibit secondary flaking on the rounded end and/or one or both lateral edges. One specimen is a center section with secondary flaking on both edges. All are plano-convex in cross section.

Type 18: Edge Fragments of Unifaces (34 specimens - No Illustration)

These are fragments broken from the edge of unifaces, either during (re)working of the edge or during its use. All exhibit a unifacially flaked edge, usually curved, and sometimes dulled by wear or grinding.

Type 19: Irregular Core Scrapers (4 specimens - Plate 4-54)
Irregular cores and core fragments that have been modified by unifacial flaking on one or more edges comprise this category. These appear to be nothing more than exhausted cores or core fragments that were unifacially flaked and/or used as expedient tools.

Type 20: Fragmentary Domed Scrapers (7 specimens - No Illustration)
These fragments are complete enough to be recognized as pieces of domed scrapers. They may be fragments of domed, miniature domed, or irregular domed types.

Type 21: Burin(?) (1 specimen - Plate 4-55)
This is a small blade, low triangular in cross section and leaf-shaped in outline, with a broken base. It is bifacially retouched nearly the full length of one edge and approximately one-third of the second edge. The remainder of the edge is unifacially retouched on the outside face of the flake. The flake scars along the edge are only 2 to 3 mm in length, except on one edge near the tip where flake scars extend to the medial ridge. Two burin facets occur at the tip of the blade where flakes have been removed from each edge, creating a small chisel-like tip.

Type 22: Borer(?) (1 specimen - Plate 4-56)
This tool is made on a fan-shaped, broken basalt flake with a plano-convex cross section. The convex edge is unifacially flaked where the straight lateral edges are broken. Near one end of the convex edge is located a broad short projection with a convex end. The edges of this projection are bifacially flaked, but with a strong tendency toward unifacial flake removal from opposite faces on opposite edges of the projection.

Type 23: Adze Blades(?) (2 specimens - Plate 4-57)

PLATE 4-55. TYPE 21 BURIN (?)

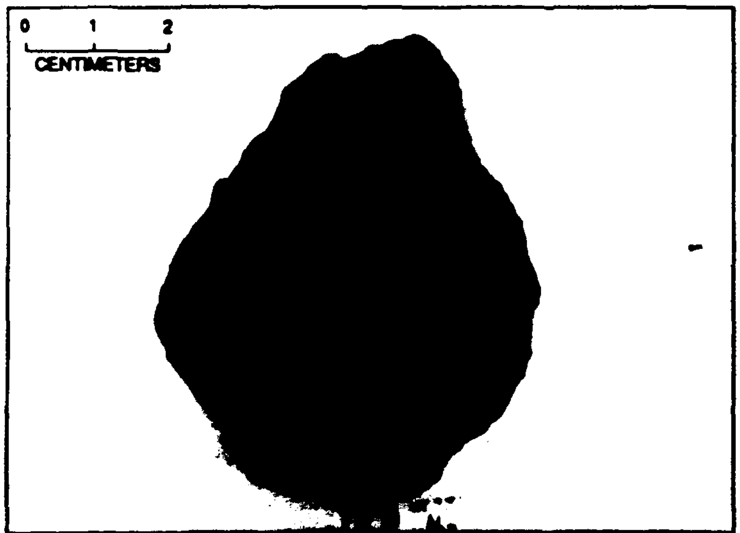


PLATE 4-56. TYPE 22 BORER (?)

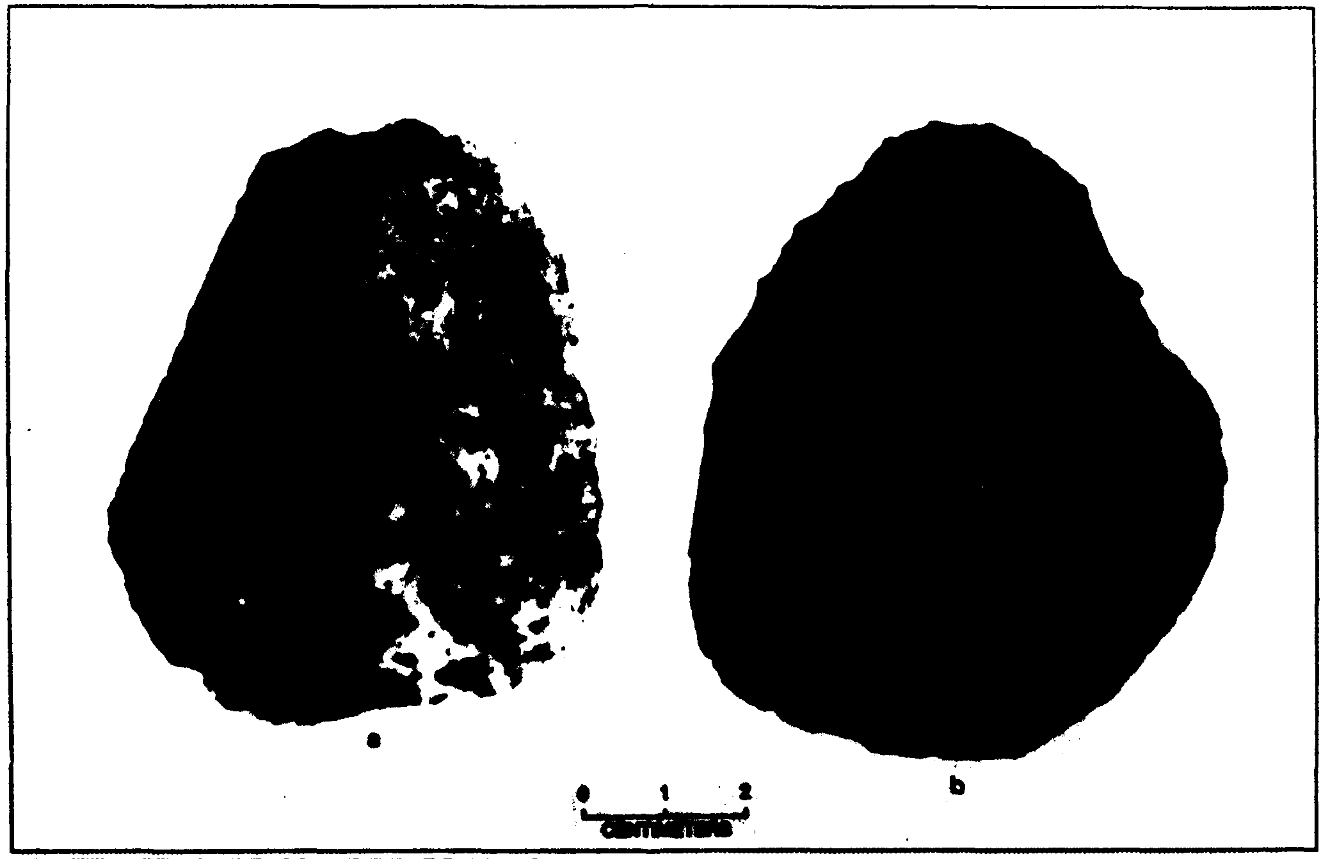


PLATE 4-57. TYPE 23 ADZE BLADES (?)

Two flaked stone implements resemble flaked adzes in form. They are both ovoid in outline with one end broader than the other. One specimen (Plate 4-57, a) is lenticular in cross section and formed by well controlled bifacial percussion followed by unifacial and bifacial pressure retouch. A broad convex edge exhibits large percussion flakes driven off and step fractures one face, and numerous single step fractures on the opposite face. The second specimen (Plate 4-57b variesin cross section from Plano-conaca at the broad end to lenticular at the narrow end. This specimen is made on a primary basalt flake and the broad cutting edge is formed by the cortical surface and interior flake surface. This edge appears to be modified only by use, exhibiting numerous flakes terminating in step fractures, removed from the cortical face (virtually every flake scar terminates in a step fracture). There are almost no flakes removed from the inside flake surface. The narrow end of this tool has been crudely bifacially flaked by percussion, forming a sinuous, irregular edge. This bifacial flaking was apparently conducted in order to reduce the thickness of the striking platform and bulb located at that end.

GROUND STONE AND OTHER ITEMS by Kathleen Ann Bergin

INTRODUCTION

A considerable number of ground stone tools were collected from the Nelson Wash site complex. Among these are millingstones, both block and slab forms, two types of manos, and miscellaneous other ground stone, most of which are from site 4-SBr-4966. Described in the "other items" category are six hammerstones and four crystals. The latter are unaltered but were found associated with cultural material and may represent an other than functional sphere of prehistoric society.

Millingstones

The 46 millingstones and millingstone fragments recovered from the Nelson Wash site complex define a ground stone component of these Lake Mojave-Pinto period sites. Only three sites contained ground stone, 4-SBr-4963, 4-SBr-4966 and 4-SBr-5267, but approximately 90% of the millingstones were derived from the Henwood site (4-SBr-4966). Most of these tools were found at the surface and are therefore difficult to date. Millingstones are tools essentially thought of as used within a subsistence system that depends to some extent on small hard seeds. Millingstones, especially those with plane surfaces, could also have functioned with pulping planes, perhaps for extracting fibers from plants. Other possible functions for millingstones include grinding pigment, reducing temper for the manufacture of pottery (none found in the site complex), perhaps preparing hide or crushing or grinding other materials such as bone.

The millingstones were arbitrarily divided into two groups based on thickness of the tool. All those 6 cm or less were labeled slab millingstones while those greater than 6 cm were designated as block millingstones. Forty millingstones were classified in this way, and 65% of these are slabs. The slab millingstones tend to be rectangular or subrectangular in cross section, and present plane or very slightly rounded corners on utilized surfaces. They come in a wide range

of raw materials. Block millingstones, on the other hand, exhibited two forms of use surface, plane, as with the slabs, and also a shallow basin. The raw material utilized was more uniform, with coarse-grained granite predominating, and the cross sections are generally irregular or amorphous. None of the tools (with edges) appear to have been shaped.

The millingstones, as well as the other ground stone tools, suffered considerable attrition due to wheeled and tracked vehicle traffic on the surface of the site. Very few of the millingstones were recovered whole, and the slab millingstones were exceptionally susceptible to fracture because of their thinness. Most of the millingstones had to be refitted before they were analyzed.

Wear on the millingstones is most frequently apparent as a smoothing or flattening of individual grains or crystals that can extend over the entire tool surface. Other common utilization characteristics include peck marks resulting from fabricating or roughening the surface, striae probably resulting from the act of grinding, and moderate- to high-luster polish. Attributes of individual millingstones are reviewed in the following section.

Attributes

Slab Millingstones (26 specimens - Plate 4-58a)
Slab millingstones are characterized by a maximum thickness of 6 cm or less and by a lack of concavity on the use surface. Twenty-six of these tools were collected from the Nelson Wash area, all but one from site 4-SBr-4966. Eighteen (78%) were recovered from the surface, and the remaining eight were found at depths between 10 and 40 cm. Half (50%) of the millingstones were ground unifacially; the remainder exhibit bifacial use. All but one (178-23) are incomplete, and some of the fragments are quite small.

The millingstones were formed from tabular sections of raw material by grinding, and sometimes pecking, the surface of the stone. The predominant raw materials represented among the slab millingstones are granite, usually fine-grained, and greenstone, an altered basic igneous rock.

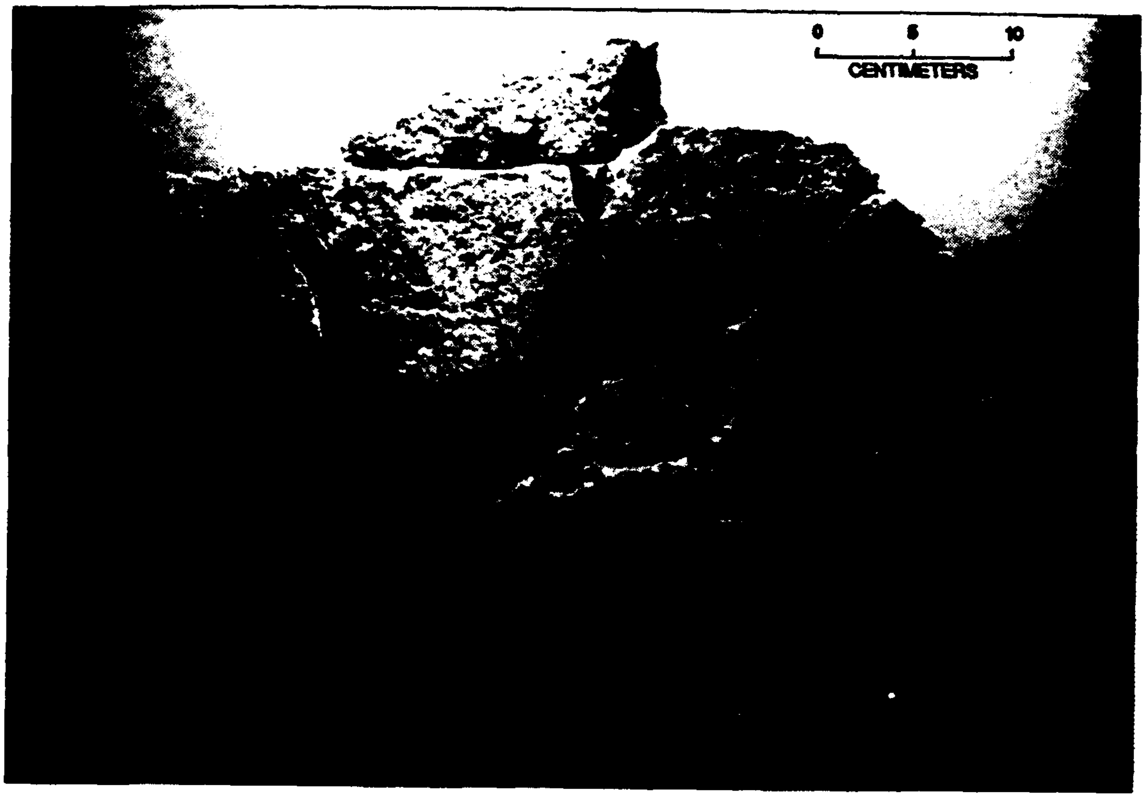


PLATE 4-58. MILLINGSTONES. a: Slab Millingstone; b: Block Millingstone

Other materials represented include gneiss, sandstone, quartzite, felsite breccia and shale. The use surfaces generally reveal a smoothed, ground appearance, and some exhibit peck marks, striae and a high polish. Cross sections are generally rectangular, and no shaping of the tools is apparent. Slab millingstones were thought to have first appeared in the prehistoric record during the Pinto period, about 5000-2000 B.C., and persisted into late prehistoric times, as evidenced by the Oro Grande occupation where they were associated with Cottonwood points dating from around A.D. 840-1300 (Rector et al. 1979:137). The data from the Nelson Wash site complex, however, suggest an older date.

A few millingstones exhibit a highly polished utilization surface with the polish occurring as isolated patches, linear strips, or larger areas. Included among these are specimens 178-870, 178-871, 178-3397, 178-5212, 178-5366, 178-5599, 178-7778, 178-6102, 178-6764, and 178-7843. The polish extends over the majority of the utilization surface on artifacts 178-3397, 178-6102, and 178-7843, and the latter two could be termined grinding slicks. Both surfaces of 178-6102 are highly polished and they exhibit sets of parallel striae that are perpendicular to the long axis of the tool fragment (3 fragments). One edge is present, and the use area near it has been pecked; both utilization surfaces measure 17.5(L) X 4.5-6.5(W) cm. On millingstone 178-7843 (2 fragments), another bifacial tool, the high luster is apparent as wide strips on one surface with striae that parallel the strips. Item 178-3397 is quite small with a slightly irregular but very smooth surface with a high luster. No pecking or striae are readily apparent. The other millingstones listed above exhibit isolated smoothed, polished areas, usually with peck marks. Striae are also visible on these tools. Item 178-871 is bifacial but one surface has partially exfoliated The use areas measure 36.5 X 12 cm and 8.5 X 8.1 cm, and are partially caliche encrusted. Specimen 178-5599 is unifacially ground with polish on the high points; less than five striae are visible. The others exhibit a similar wear pattern with polish on the tools' higher points, and some pecking and striae. Millingstone 178-7778 may be a complete tool manufactured from a broken rock fragment. The use area is centrally located and measures about 16 x 13 cm. This area is also discolored to a lighter shade, possibly by grinding off the patinated surface.

Two large millingstone fragments (178-7777, 178-7779) are almost completely encrusted with a calcium carbonate skin, making them difficult to describe. Both are thick, apparently unifacial slabs fabricated of granite. They are midsections, and the completed millingstones must have been quite large and heavy. These tool fragments were recovered from the surface of nonlocus area of the Henwood site.

Millingstone fragments 178-771 (3 fragments) and 178-774 (2 fragments) refit to form one incomplete bifacial millingstone. Also recovered from the surface of the Henwood site (nonlocus area), the two sets of fragments were found about 6 m apart. One surface was used more intensely than the other, and it yields a smoothed, ground down appearance with one linear polished area, some peck marks near the tool edge and some striae with variable orientations. The opposite surface was not as heavily utilized. Individual grains are still distinct, but it is apparent that the projecting grains and/or sections have been ground down, with an overall flattening of the (crystal) grains on the surface.

Two millingstones (178-23, 178-26) were collected during the 1982 Gallant Eagle survey (Robarchek et al. 1984) and were described by Vaughan at that time (Vaughan and Warren 1984:584). Item 178-23 is a small complete unifacial grinding tool that exhibits striae parallel to the long axis of the tool, as well as numerous peck marks. The specimen was not shaped. The use area measures approximately 16 X 12 cm, and it is discolored to a lighter tone than the rest of the surface. Millingstone 178-26 is an incomplete bifacial tool found in two pieces. Unlike the typical rectangular cross section of the slab millingstones, this item is slightly plano-convex. The flattened surface has a more weathered appearance and exhibits numerous peck marks. The opposite, slightly convex surface has also been pecked, but striae, generally oriented along the length axis, also occur. This end fragment indicates a finished product that must have been generally small in size, probably not much larger than millingstone 178-23. Both utilization surfaces have been varnished by natural processes.

The remaining millingstone fragments are quite variable, especially in size. Specimens 174-377 (six fragments), 178-5887, 178-5900, 178-6004, 178-7481, and 178-7787 are quite small tool

sections. Items 178-5887 and 178-5900 are probably fragments of the same bifacial tool. The raw material and tool thickness are identical, and they were found about 1 m apart, just beneath the surface of Locus E. The use wear is also strikingly similar. Striae with one prominent orientation are visible on both surfaces, and some pecking is present.

Specimens 174-377 and 178-6004 are small unifacial fragments, and items 178-7481 and 178-7787 are bifacial fragments. Pecking is pronounced on 178-6004, and this item has a coating of calcium carbonate. One surface of millingstone 178-1481 has almost completely exfoliated, and the opposite one is slightly convex; a few striae are visible on this surface. The slightly rounded edge of this tool gives some indication of having been shaped. Both surfaces of specimen 178-7787 were marginally used, though one presents a more smooth, ground down appearance than the other. Parallel striae are readily apparent on both surfaces.

The five remaining millingstone fragments are larger than those just described, and all were recovered from the surface. Specimen 178-868 consists of nine fragments which could not be completely refitted. It is a bifacial tool manufactured from an extremely friable breccia. Both surfaces have been ground smooth, making them harder and more resistant to decomposition than the sides of the fragments, which continue to crumble. A calcium carbonate deposit partially covers one surface. Specimen 178-5544 is a thick slab whose underside has exfoliated. The use surface has been ground smooth, and some pecking and striae with variable orientations are visible.

Dense metamorphic rocks were utilized for unifacial millingstones 178-4217 and 178-7773 and bifacial millingstone 178-7781 (six fragments). Specimen 178-4217 is an end fragment with overall polish that is probably desert varnish, a result of weathering. The use area measures approximately 15 X 11.5 cm and is slightly concave (about 0.325 cm depressed). Pecking is present and a few striae with various orientations are visible. Specimen 178-7773 exhibits slight smoothing and pecking on one surface. The bifacial millingstone, 178-7781, was refitted to form a C-shaped section. Both utilization surfaces exhibits pecking and striae.

Block Millingstones (14 specimens - Plate 4-58b)

The 14 block millingstones recovered from the Nelson Wash site complex are greater than 6 cm thick and exhibit two forms of use surface: a plane or almost plane surface (12 items) and a shallow basin (two items). Fifty percent of the blocks show unifacial wear, 43% bifacial wear, and one specimen is trifacial. Irregular, amorphous cross sections are present, depending on the natural shape of the block. Unlike the slab metates, which exhibit a wide range of raw materials, the block millingstones are fabricated predominantly of granite (86%), and the coarser-grained varieties are more frequent. As is typical of other tool classes, the majority of the block millingstones (12) were recovered from the Henwood site (4-SBr-4966); another two were collected from the surface of site 4-SBr-5267. Only three were found subsurface, between 10 and 40 cm at the Henwood site.

High polish is exhibited by four metates with flat use surfaces: 178-7774 (Plate 4-59, a) 178-7775, 178-7776 and 178-7780. Polish is more highly developed on millingstone 178-7780 than on the other three. The bifacial tool of granite shows high polish in a roughly oval area, measuring 10.4 X 7.9 cm, located in the central portion of one use surface. Patination, still present in varying degrees on the rest of the surface, is absent in the polished area. The entire ground surface approximates 15.5(incomplete) x 12 cm, and a few striae are visible. The opposable surface was ground less intensively than the first and it has partially exfoliated.

Granite millingstones 178-7775 and 178-7776 show similar development of polish, but not to the same degree as specimen 178-7780; the polished areas are the most ground. Both these items show circular areas of polish in well ground, central portions of the use surface. About 80-85% of specimen 178-7775 is caliche encrusted and a portion of the ground surface has exfoliated, but polish is still prominent in a slightly concave area, approximately 17 cm in diameter, that is surrounded by polished strips. Pecking is apparent around the edge of this surface, but no striae are visible. Item 178-7776 has a ground surface, approximately 23 X 26 cm, that presents a circular polished area about 8 cm in diameter. Polished strips radiate from the central polished area where all patination has been removed. Some striae with irregular orientations are visible on the ground surface.

Millingstone 178-7774 has polish distributed in a linear rather than circular pattern. The polish occurs in parallel strips that extend the length of the use surface, and is apparently the result of grinding down high points on the tool surface. Overall dimensions of the ground surface are 27 X 12 cm. No pecking or striae occur on the unifacial granite tool.

The basined areas of millingstones 178-869 and 440-606 also are characterized by a high luster, probably attributable to these areas being more intensively ground, either during the formation of the basin or from use. The basin is most pronounced on one surface of the bifacial millingstone (178-869) and it was probably pecked into shape rather than ground down. The use surface measures about 26 X 20 cm; centrally located is a shallow basin, approximately 13 X 12 cm, that is about 0.9 cm deep. The opposite surface is about 70% removed through exfoliation. The portion present is a plane surface that measures approximately 30 X 18.5 cm and shows prominent pecking.

The basin of millingstone 440-606 is less well developed than that of specimen 178-869, and the polished area is more discontinuous. This millingstone is unifacial with a ground surface measuring 27 X 19 cm. The central portion of the use area is concave, depressed about 0.3 cm in a 10 X 8 cm area. This depressed area is outlined by a concentric, highly polished band, about 3 cm wide, that is oval and measures 18 X 10 cm. Peck marks are prominent both on the interior and exterior of this band. Parallel sets of striae with variable orientations are prominent across the basined utilization surface.

The only other millingstone collected from site 4-SBr-5267 is specimen 440-415, a bifacial millingstone with two nonopposing surfaces. It is a midsection of an exfoliating granite block that is roughly plano-convex in cross section. The second surface, measuring 16 X 6 cm, may have been developed after the original tool broke. Both ground areas form plane surfaces, and the larger ground surface measures approximately 15 X 11 cm. Minor pecking occurs on both surfaces, as do small polished patches or ridges. Very few striae are visible.

Specimen 178-7784 is the only ground stone item that shows trifacial use. This midsection was recovered in 10 fragments from the surface of the Henwood site. Manufactured from a coarse-grained granite, it is triangular in cross section and exhibits prominent pecking on two surfaces, the other being too fragmentary to make a determination. The portions of use surfaces present measure 15 X 11.4 cm, 16 X 11.3 cm, and 4 X 5.2 cm. The first gives a more utilized appearance, being ground down to a smooth plane. The second has been roughened by pecking and is slightly concave.

The remaining six millingstones are either unifacial (178-5367, 178-7783, 178-7785) or bifacial (178-7033, 178-7723, 178-7782). The first is a small midsection fragment, trapezoidal in cross section, that shows unifacial wear. No pecking, polish, or striae could be seen on the use surface which measures 15 X 7 cm. The other two unifacial millingstones are large, almost complete, tool sections. Specimen 178-7783 consists of four granite fragments that were refitted. The ground surface is oval in shape and measures 19 X 15 cm. Some pecking and discoloration, due to the removal of patination, occur on the use area. Millingstone 178-7785 is a long, narrow tool section formed on a rectangular block of basalt with some fragments of calcium carbonate adhering to it. The use surface has been ground but no pecking, polish, or striae are obvious.

Minor polish on the surfaces of the three granite bifacial millingstones attest to the intensity of use of these surfaces. One surface of midsection 178-7033 gives a more ground down appearance than the other, which exhibits pronounced pecking. Specimen 178-7723 is another small midsection, but both utilization surfaces present a smoothed, very ground down appearance. This artifact is about 65% caliche coated, but pecking and minor polish are visible on both surfaces. In cross section, the tool is wedge-shaped, and one surface is flat while the other is just slightly concave. A large corner section consisting of two fragments, item 178-7782 would have been quite a large millingstone when complete. It too is more or less wedge-shaped in cross section, but both utilization surfaces form planes. Polish occurs in longitudinal strips, very similar to millingstone 178-7774 but with less luster. This resulted from the grinding of higher projections on the irregular surface after it had been roughened by pecking. Peck marks

are more apparent at the edge of the use surfaces, where they have not been obliterated by grinding. One ground surface measures 23(incomplete) X 33 cm and the other about 19(incomplete) X 23 cm.

Manos

Thirteen manos were recovered from three sites in the Nelson Drainage area: 4-SBr-4963, 4-SBr-4966 and 4-SBr-5267. Modification is limited primarily to use wear, but some of the tools had been shaped by pecking and/or grinding. Eight of the manos are complete and the remainder are fragments of varying size. The artifacts have a high specific gravity and were manufactured from locally available materials including granite, granodiorite, basalt, greenstone rhyolite, tuff, and quartzite. Amorphous- to oval-shaped cobbles comprise the raw tool forms. The manos were grouped into two types based on general outline and the extent of shaping. Generally, amorphous to rounded handstones with little or no shaping are grouped as unshaped manos in Type 1. Type 2 manos are shaped, tending to be rectangular to subrectangular in outline and cross section. One mano (178-8128) was so fragmentary (14 pieces) that it was impossible to assign to either type category. This granite mano may have experienced secondary use as a hearthstone or may have been fire-affected in another way, leaving it in an extremely friable condition. The one mano from site 4-SBr-4963, found on the surface, is classified as Type 1. Eight of the nine handstones retrieved from the Henwood site (4-SBr-4966) were classifiable, the other being too fragmentary. Five of these manos are Type 1, and the remaining three are Type 2. Both types were recovered from the surface and from depth. Of the three handstones recovered from the surface of site 4-SBr-5267, two are Type 2 and the other is Type 1.

Type Descriptions

Type 1 Manos (7 specimens - Plate 4-59, a-c)

The seven manos included in this type are rounded-amorphous to amorphous-shaped artifacts with use surfaces that are distributed as compatible with the raw form of the tool. Six specimens

PLATE 4-59. MANOS. a-c: Type 1; d-f: Type 2

are complete tools (174-473, 178-5598, 178-5725, 178-7276, 178-7790, 440-469) and one is a fragment (178-5795).

Items 178-5598 and 178-5725 (Plate 4-59, c) were manufactured from rounded cobbles, and are circular to oval in outline and elliptical to sub-trapezoidal in cross section. Two use surfaces are evidenced by polish on artifact 178-5598; one of these is flattened while the other is rounded. Pecking forms an oval measuring 7 X 5.5 cm on the flattened surface, and pecking is also prominent on one end of the tool. Mano 178-5725 also presents two primary use surfaces, but one of these received more utilization than the other. One surface, 6.4 X 4.6 cm, has been flattened and polished by use and exhibits radiating striae. The use surface meets the rest of the cobble at sharp angles. The opposite face has been flattened and smoothed to some extent, but it still remains slightly rounded. Pecking is pronounced on both ends of the cobble and surrounds the one small well-defined use surface. Pecking at one end may represent an initial attempt at shaping the circumference of the tool since a flattened area was formed. On the side adjacent to this is a flattened surface that angles between the two primary use surfaces. This too could represent an intent to shape the mano, but it could also represent the development of another grinding surface.

The five remaining Type 1 manos were fabricated from subangular amorphous cobbles and present irregular outlines and cross sections. Specimen 440-469 exhibits three use surfaces, two of which are well defined. One well utilized surface is shouldered and forms an oval shaped flattened plane, approximately 7.3 X 5.2 cm, that was apparently pecked then ground down. The opposite face is marginally flattened but does not give a shouldered appearance, and polish is more apparent on this surface. Use of a third surface, situated on the lateral edge of the tool perpendicular to the first two surfaces, is also apparent by polish. Peck marks surround the second surface described as well as in its interior, and one end of the mano has been battered.

Artifact 178-7790 is a primarily unifacial mano with a shouldered utilization surface. The use area is a subtriangular plane measuring 10.1 X 5.5 cm and polish and pecking are especially apparent along the margins of the surface. Striation parallel to the long axis is also displayed.

The opposite surface has been pecked and may have been minimally ground. Another unifacial mano, 174-473, presents a marginally shouldered appearance. The use surface is rhombohedral in shaped and measures about 7.7 X 5.8 cm. Pecking is still prominent on the use surface and along its circumference. The artifact had been used enough to wear down and smooth the minuscule projections originally occurring on the surface, but not enough to obliterate the pecking scars that probably occurred in the manufacturing stage.

Two adjacent use surfaces are apparent on specimen 178-7276. One surface is a well defined D-shaped area with approximate dimensions of 6.8 X 5.5 cm. This surface has been worn down through use and striae in two directions are visible. The second use area is adjacent to the first and forms an approximate right angle juncture with it. This surface is B-shaped and measures 5.9 X 3.7 cm. Some striae can be seen to form a radiating pattern in one portion of this surface. One projecting tip of this artifact has been battered.

The remaining Type 1 artifact is a mano fragment (178-5795) with a shouldered appearance and one apparent use surface. This item is friable and may have been fire-affected. It has a calcium carbonate (caliche) skin over much of its surface; item 178-7790 also had some carbonate deposition, but not to the degree that artifact 178-5795 does.

Type 2 Manos (5 specimens - Plate 4-59, d-f)

Five manos are categorized as Type 2 specimens because they have been formally shaped into subrectangular forms, usually by pecking and grinding, and they also exhibit a rectangular to subrectangular cross section. Two are complete specimens (178-4303, 178-6158), and the remaining three are fragments (178-4213, 440-46, 440-423), with both 178-4213 and 440-46 each composed of two pieces. All but one (178-4303) of the Type 2 manos are bifacial, with opposable faces serving as use surfaces. A caliche skin completely covers artifact 178-6158, making description of the tool difficult.

Manos 178-4213 (Plate 4-59, e) and 440-46 are most similar. The former is probably the most formal tool present among the manos. All four sides have been pecked into shape and three

have been further shaped by grinding, forming almost right angle intersections. The artifact definitely has a shouldered appearance, and the use surfaces are slightly rounded, measuring 11.5 X 6.7 cm on one face and 10 X 6.7 cm on the other. Pecking is especially apparent along one margin of the tool. Artifact 440-46 is more fragmentary than the former, which yielded complete measurements, but does appear to be similar in form and mode of manufacture. The three lateral edges present were ground into shape to form approximate 80 degree angles at their intersections. The artifact is opposable bifacial with slightly rounded use surfaces, but one surface is considerably more worn down than the other and its width (the only complete dimension) is 7.2 cm.

Very similar to the first two specimens described is artifact 440-423 (Plate 4-59, d). This item, however, is more rounded in outline and is wedge-shaped in cross section and made of granite. Portions of the tool have exfoliated, and one small piece is missing, but complete measurements could be taken. The two use surfaces measure about 7.5 X 9.5 cm and 6.9 X 7.8 cm and are set at an approximate 30 degree angle with 1.2 cm separating the two surfaces at one end and 4.9 cm at the other. One use surface is worn smooth to a slightly rounded appearance while the opposite is a plane surface that may have received greater attrition. The lateral edges of the mano have been pecked, presumably for shaping; no indication of edge smoothing is apparent, but the nature of the granite may have removed evidence of further treatment.

Artifact 178-6158 is completely encrusted with a caliche skin, making description of the item difficult. It does appear to have been pecked into shape and has a more rounded outline than the first two Type 2 manos described. Striae, polish, or shallow pecking cannot be seen on this artifact. One surface is flattened and smooth. The opposite is rounded and slightly irregular, but also appears smooth. Peck marks occur along the margins of the tool.

The only basalt handstone recovered (specimen 178-4303) is a dense vesicular item that may have been broken and reworked. This artifact is thick, plano-convex in cross section and has been shaped on all surfaces by pecking and/or grinding. Three surfaces have been worn to planes, presumably from use, although one of these surfaces may have resulted from grinding

to smooth a break. The largest use surface measures 6.7 X 4.6 cm; the remaining two are at an angle to the first and to each other. The latter measures 5.0 X 4.0 cm and 4.2 X 4.5 cm, the last perhaps the result of smoothing a break. Some calcium carbonate deposition is prominent in a band completely encircling the tool.

Other Ground Stone

Eight ground stone items of ambiguous or unidentified function were recovered. Five were collected from the surface of sites 4-SBr-4963, 4-SBr-4966, and 4-SBr-5267, and three were recovered at depth from site 4-SBr-4966. All are manufactured from locally available igneous or metamorphic rocks.

Item 178-5336 is a block or slab millingstone section that has been unifacially ground. The millingstone fragment presents a wedge-shaped cross section and the tool margin has been flaked. Slight polish is apparent on the use surface. Specimens 178-5336 and 178-8163 are broken ground stone tools. Specimen 178-8163 is a mano or millingstone fragment that shows bifacial wear. It was found on the surface of Locus B at the Henwood site. One surface is planar and the opposite is just slightly convex. Both are ground smooth and some pecking is apparent at the margin of the use surfaces. The section of tool edge present is rounded, but does not appear to have been shaped. If it is a millingstone fragment, it would be classified in the slab group; if a mano, it would be a Type 1.

Artifacts 174-140, 178-5166, and 178-7845 are broken ground stone tools that were prepared for or served secondary functions. The first is a small triangular section of a bifacial slab millingstone. The tool edge has been shaped to form a sinuous outline, and the broken edges of the artifact have been battered.

Tool 178-5166 is a slab millingstone midsection that has been flaked along three sides after is was broken. No battering or other wear is evidenced along the flaked edges. The millingstone was ground unifacially to a smooth, slightly rounded surface that exhibits moderate polish. It

is evident that some of the surface was pecked prior to being ground. Numerous striae, generally parallel to the short axis of the tool, are present.

Specimen 178-7845 is a broken mano or metate fragment that has been ground flat on one surface and whose opposing surface is essentially gone. The original tool was approximately 6.25 cm thick. Approximately 80% of the tool surface is encrusted with a calcium carbonate skin, making the presence or type of wear difficult to determine. The broken underside of the tool, however, appears to be notched, and may have served as shaft straightener or smoother. A slightly curvilinear depressed area about 1.2 cm wide and 4.3 cm long occurs near the edge of the broken surface. One termination has been notched deeply, approximately 0.6 cm. From this notch, the groove slopes sharply upward for about 3 cm, and then gradually widens to about 2.2 cm with a shallower depth of 0.3 cm, only to narrow and deepen slightly at the opposite termination. In cross section, the groove varies from a sharp V to a shallow wide-open shape.

One of two complete items in this grouping, 178-8142, was recovered at 19 cm depth from Feature 6 in the nonlocus area of 4-SBr-4966. This is a ground felsite cobble that is difficult to analyze because of a relatively thick caliche deposit over 65-70% of the item. The ground surfaces are rounded rather than flattened.

Another complete specimen, 440-121 is a limestone cobble, flattened on two sides and lenticular in cross section. Apparently the item has been lying on one surface for quite some time since one face is smooth but hydrated and the other shows considerable evidence of weathering. A very narrow crescentic area along the tool margin is unweathered and shows a high polish, which may indicate that the cobble was a ground stone tool. Aside from this and a single flake removal, which may or may not be natural, the item appears unaltered. It does present a regular, oval outline but it is impossible to determine if shaping occurred. Limestone is a soft, easily eroded rock, and extensive use wear, if any were present, has long since been eradicated. The specimen was collected because limestone is rare in the Nelson Wash environment, which is abundant in igneous and metamorphic, not sedimentary, rocks. Item 440-121 also shows

some characteristics of a beach cobble, and may have been transported to site 4-SBr-5267 from a shoreline feature in the Nelson Basin area or elsewhere.

An unusual item of chlorite schist (178-6896) was found at the Henwood site, in the 30-40 cm level of unit S1656-E2075 at Locus G. This tool resembles a shallow mortar due to the presence of a circular hole, 10 cm in diameter and 1.3 cm deep, that was apparently pecked into the platy metamorphic material. The depression is approximately centrally located, and the surrounding surface may have been ground. The nature of schist and the calcium carbonate deposit over much of the artifact's surface makes it difficult to determine characteristics of a ground surface. In shape, if not in use wear attributes, this specimen resembles the "basined" grinding stones described under block millingstones.

Other Items

Ten non-ground stone items are described in this section. Six are hammerstones whose common characteristic is the presence of battering or crushing, whether on a flaked or unmodified surface, not a common production strategy such as grinding versus flaking. The other four items are small unaltered crystals of either quartz or garnet.

Descriptions

Hammerstones (6 specimens)

The six hammerstones recovered from the Nelson Wash study area display a broad range of characteristics in terms of size, raw material and distribution of wear. Five tools were collected from site 4-SBr-4966, two at depth, and the remaining one came from the surface of site 4-SBr-4967. Hammerstones are generally characterized by evidence of crushing or battering on the tool, received in the reduction of flaked stone tools, the manufacture (pecking and shaping) of ground stone or the production (pecking) of petroglyphs. They also could have been used for processing food resources by pounding and crushing, or served other functions. The seven

hammerstones discussed here are complete tools, and one (178-34) has been described earlier by Vaughan (Vaughan and Warren 1984). They were manufactured from cobbles of locally available raw materials, predominantly altered basic igneous or sedimentary rocks (metabasalt, greenstone, quartzite) with a high specific gravity.

Hammerstones 178-824 and 178-4818 display use wear in the form of crushed and/or battered edges around the entire circumference of the tools. Specimen 178-824 was fabricated from a large decortication flake or split cobble. It is oval in outline and thick lenticular in cross section. Numerous flake scars along the tool edge display irregular orientations, and these may have resulted from the use of the item or by environmental factors during subsequent weathering. The flake scars and tool form have been rounded and polished by erosional processes, and numerous small conchoidal fractures occur as well. The raw material is such a highly altered form of basalt that it more closely resembles chert. It has a conchoidal fracture and a hardness of 6 1/2-7, but it does retain a marginally platy structure.

Specimen 178-4818 is an angular cobble with approximately eight plane surfaces. Five large flake removals occur along the circumference of the tool, probably to prepare the edge to function as a hammerstone. Both specimens 178-4818 and 178-824 were found at the surface, but 178-4818 does not exhibit the rounded weathered appearance that 178-824 does, and the former's edges have a more crushed use pattern.

Unlike the first two tools described, where relatively thin sinuous edges were used for striking, the rounded unmodified perimeters of hammerstones 178-440 and 178-7849 were utilized. The granite hammerstone, 178-440, decays more readily than the quartzite one (178-7849), and three battered areas varying in length from 3.3-4.6 cm, with an average width of 2.2 cm, are present on this tool. The use wear on item 178-7849 has a more linear distribution, appearing as a series of peck marks that partially (about halfway) encircles the artifact. Both tools are oval in outline and circular to lenticular in cross section.

On hammerstones 178-34 and 179-67, both thin sharp edges and rounded unmodified areas were used for hammering. Vaughan reports that several flakes removed from one face of the battered area on item 178-34 may have served to prepare the area for hammerstone use (Vaughan and Warren 1984:586). One end of the chalcedony artifact, 179-67, is prominently battered. Numerous flake removals occur on this small chalcedony cobble, which may have originally served as core. The battering is limited to one end, but both the rounded unmodified surface and the perimeters of flake scars in this area exhibit use. Artifact 178-34 is subtriangular in outline and cross section, and hammerstone 179-67 has an amorphous outline and cross section. The former has a thin carbonate skin covering a portion of the tool, probably derived from the soil since this tool was recovered at depth (10-20 cm).

Crystals (4 specimens)

Four small crystals have been recovered from the Nelson Wash site complex: two from site 4-SBr-4966 and two from site 4-SBr-5267. Three are quartz and the other is a garnet. All are small in size and were recovered either from the surface or the 0-10 cm excavation level.

Quartz crystals form in the rhombohedral division of the hexagonal crystal system and are typified by three-fold symmetry. The three recovered crystals are hexagonal prisms and, where terminations are present, these are formed by a combination of positive and negative rhombohedrons with one rhombohedron dominating. The axes of specimen 440-455 are of equal length, forming a prism with faces of equal width. One axis of specimen 178-910 is longer (1.4 cm) than the other two (1.05 cm), making two faces of the prism wider than the other four. Specimen 440-403 is broken longitudinally, making estimations of axes length and prism symmetry impossible to determine. Horizontal striae, characteristic of quartz prisms, are present on two of the crystals. Two adjacent faces of item 440-455 exhibit striae, as do all six faces of specimen 178-910.

The best crystal termination occurs on specimen 178-910. Here two rhombohedrons occur in combination forming a complete termination with six adjacent surfaces resembling a hexagonal

dipyramid. The opposite termination is poorly formed with only two rhomb faces evident. On specimen 440-455, both terminations are poorly formed. One prominent rhombohedron is evident on one end while the opposite termination exhibits four faces and is rounded and covered with approximately 50 small conchoidal fractures. Both terminations of the broken crystal 440-403 are poorly formed with many conchoidal fractures present. There is some indication, however, that two rhombohedrons in combination with one dominant are the terminations.

All three quartz crystals have a hardness of 7 and a vitreous luster but specimens 178-910 and 440-455 are less lustrous than specimen 440-403. The prism faces of these latter two exhibit some etching. Item 440-403 is transparent while specimens 178-910 and 440-455 are translucent (with a cloudy appearance).

The fourth recovered crystal, a garnet, probably almandite, is smaller than the other three, and it grew in the isometric crystal system with a form that is a combination of dodecahedron and trapezohedron. It has a hardness of 6 1/2-7, a vitreous luster, and is red to dark reddish-brown in color. The crystal is opaque but portions of it are translucent.

CHAPTER 5 - MICROWEAR ANALYSIS OF SELECTED FLAKED STONE TOOLS

by Douglas B. Bamforth

This report presents the results of a microwear analysis of 72 tools from four sites in Nelson Wash, Fort Irwin, California. The method of microwear analysis applied here was developed by Keeley (1980) and has been experimentally shown to reliably yield specific interpretations of the tasks for which prehistoric tools used (Bamforth 1988; Bamforth and Burns n.d.; Keeley 1980; Gendel and Pirnay 1982; Knutsson and Hope 1984). This method is based in the analysis of polishes, formed on the edges of stone tools during use, at magnifications from 100x to 400x. In combination with observations of lower-magnification traces such as striae and edge damage, this examination forms the basis of a complete interpretation.

Detailed and extensive research has demonstrated that distinctive microwear polishes are formed by use on meat, wood, bone and antler, fresh hide, dry hide, plants, and shell (Bamforth 1980; Keeley 1980; Vaughan 1985; Yerkes 1983). Although there is some debate about the processes which lead to the observable differences in these polishes (Anderson 1980; Meeks et. al. 1982; Unger-Hamilton 1984), there is presently no reasonable doubt that there is substantial variability in the appearance of microwear polishes and that this variability can be linked to the specific nature of the material on which flaked stone tools were used. The remainder of this report discusses this method in somewhat greater detail, presents the techniques used in applying it to the Nelson Wash collection, and evaluates the results of this application.

MICROWEAR ANALYSIS

At this writing, there is a fairly high degree of skepticism among American archaeologists concerning the reliability of the method of microwear analysis used in this report. Given the extensive evidence supporting the method, the basis for this skepticism is somewhat obscure, but it has likely developed in part because of the number of researchers who have invested large amounts of time and energy in an alternative approach to microwear analysis. This approach relies only on low-magnification (below 75x) examination of edge damage patterns. Although

a substantial body of research has been published using edge damage analysis, (much of it citing the authority of Tringham et. al. 1974) only one low-magnification analyst (Odell and Odell-Vereecken 1980) has fully published the results of a test of the accuracy of his interpretations.[2] This contrasts sharply with the development of high-magnification analysis, whose reliability was tested before it was widely applied to archaeological material (Keeley and Newcomer 1977); the success of this test has been repeated several times since its initial publication (Bamforth and Burns, n.d.; Gendel 1982; Knutsson and Hope 1984).

A detailed comparison of the test performed by the Odells and that performed by Keeley and Newcomer shows substantial differences in the results of the two methods (Keeley 1981a). Comparing these results suggests that edge damage analysis is incapable of reliably producing information on the specific material on which a stone tools was used, although it is relatively useful for determining the area of a tool which was used and the general hardness of the material on which it was used. However, even at the more general levels of inference, its rate of correct identification is lower than that for high-magnification analysis. Recent results (Shea, personal communication 1988) seem to be far more promising than Odell's in this regard, but have not yet been published in a way which allows them to be rigorously compared with other tests.

Unfortunately, in archaeological practice, it is quite likely that simple edge damage analysis will produce worse results than it does in experimental tests. Archaeological specimens are subject to numerous sources of edge damage which are not problems in experimental situations, including pedoturbation, sub-surface soil movements, and post-excavation laboratory damage. Individual scars left on the edges of artifacts by processes such as these are rarely distinguishable from those produced by use; when one is superimposed on the other, the problem is immeasurably complicated. For instance, despite the fact that Odell manufactured the tools for his test himself, he consistently interpreted edge damage from retouch as being from use (Odell and Odell-Vereecken 1981; Keeley 1981a). It is almost certain that many or most prehistoric

[2]Shea (1988) has recently published a somewhat sketchy, preliminary summary of his low-magnification test results.

artifacts, particularly those recovered from the surface, will bear edge damage scars having nothing to do with any prehistoric use (cf. Keller 1979; Muto 1979).

Although a number of papers have discussed these problems (Flenniken and Haggarty 1979; Gero 1978; Newcomer 1976; Sheets 1973; Schousboe 1977; Wylie 1975), virtually no low-magnification analysts have systematically attempted to experimentally control for non-cultural sources of edge damage. The simple statement by Tringham et al. (1974:181) that non-use damage can be recognized because of its random pattern on the edge is only true in some cases. Newcomer (1976), for example, describes technological effects which non-randomly mimic use traces and even formal tool types and Bamforth (1983a) found identical problems caused by post-depositional and post-recovery processes. In contrast, Keeley (1980:25-25; also see below) has extensively discussed how the high magnification results of natural and technological processes differ from the results of use.

Despite all of this, American archaeologists have tended to react to Keeley's careful and extensive research with the enthusiasm they generally reserve for hypotheses about the influence of trans-oceanic contacts on the development of New World civilization (i.e., Holley and DelBene 1981; see Keeley 1981a in reply). However, a few people in the United States and many people in the rest of the world have extensively tested Keeley's hypotheses and have replicated all of his results. Identical suites of microwear polishes have been seen on every variety of microcrystalline silicate which has been examined, including chert from Illinois (Gerwitz 1980; Yerkes 1983), France (Anderson 1980), Washington State (Keeley 1980), Belgium (Cahen et al. 1979), and California (Bamforth 1983b); flint from Great Britain (Keeley 1980); and chert, jasper, agate, and silicified caliche from Texas (Bamforth 1980, in press). Polishes have been recognized on material ranging in age from the Middle Paleolithic (Keeley 1980; Toth 1982) to a few hundred years (Bamforth 1983b).

The available evidence thus suggests strongly: (1) that microwear analysis based primarily on the examination of use-polishes and secondarily on other use traces yields reliable, specific interpretations of prehistoric tool use, and; (2) that there are unresolved problems in obtaining

such interpretations using alternative approaches based only on lower magnification analysis. The remainder of this report is based on high-magnification analysis of microwear polishes on the study collection.

It is important to emphasize at this point that a primary emphasis on analysis of microwear polishes does not imply a rejection of the potential utility of other types of use traces. A complete program of microwear analysis integrates information on the appearance and distribution of polishes, edge damage, and striation patterns. Because of the differing reliabilities of the information which can be derived from these different kinds of traces, though, polish appearance provides the basis for the initial identification of the portion of a tool which was used, as well as most of the information needed to identify the material on which it was used. The other types of traces are particularly useful in reconstructing how the tool was used (as a knife or a scraper, for instance) and can add detail to the specific interpretation of many uses. Their presence in the absence of polish, though, cannot be taken as reliable evidence of use.

On the Logic of Microwear Interpretations

The meaning of the visible differences in the appearance of a tool's surface can only be assessed by comparison with the appearance of the surfaces of tools whose use is known. The problem for the archaeologist lies in assuring not only that a given trace can be formed by a given kind of use but also that it cannot be formed by any other use (see Keeley 1974, 1980:3-4). In practice, of course, it is not possible to experiment on every possible worked material using every possible kind of stone tool, and it is therefore conceivable that future research may show that one or more of the links between polish and use which have been hypothesized is less direct than the present data indicate; an analogous problem exists for all scientific hypotheses. However, the strength of the method of analysis used here lies especially in the diversity of experiments which provide the present basis for comparisons between tools of known and unknown use.

Literally hundreds of implements have been used by archaeologists and examined at high magnifications with essentially identical results; the patterned differences between the various microwear polishes described by Keeley (1980:35-61) can indeed be linked to specific worked materials, although some presently unexplained variability in polish appearance is known (i.e., Keeley 1980:68-69, 74-75). Statements made in later sections of this report to the effect that a particular artifact was used for a particular purpose mean that the artifact bears microscopic traces on its edges which have been experimentally reproduced by use for that purpose and by no other use. It is only because such a wide and independently replicated comparative experimental framework exists that such statements are as reliable as experiments (Bamforth and Burns n.d.; Gendel and Pirnay 1982; Keeley 1980; Knutsson and Hope 1984).

TECHNIQUE

The artifact preparation procedures used here essentially follow Keeley (1980) and are basically the same for experimental and archaeological specimens. Both experimental and archaeological pieces were first cleaned with a household cleaner and warm water and then with acetone. Experimental pieces were then immersed in NaOH for 10 minutes to remove organics; as no organics were present on the archaeological specimens, this step was not necessary. All implements were then immersed in HCl for 10 minutes, rinsed in clean water, and hand-dried. Microscopic observations were conducted using an Olympus BHM binocular microscope equipped with an incident illuminator[3]. During examination, artifacts were handled with cotton gloves to minimize the amount of skin oil deposited on them.

The standards used to describe the wear traces recognized here largely follow Keeley (1980) and Vaughan (1985). Polish identifications rely on comparisons with experimentally used tools. Descriptions of edge damage follow Keeley (1980:24-25), distinguishing scars by their size,

[3]Keeley (1980) and Bamforth (1980) discuss both the need for this type of equipment to see use-polishes and the differences between it and the stereoscopic microscopes found in most archaeological laboratories.

depth, termination, and shape. Size is classified as microscopic (less than 0.5 mm), small (from 0.5 to 2.0 mm), and large (larger than 2.0 mm). The next two variables are simply dichotomized, classifying depth as deep or shallow and termination as feathered or stepped. Three classes of shape were noted on the study collection: scalar, triangular, and half-moon (crescent-shaped breakages). The frequency of scars along the edge were generally classed as scattered, semi-continuous, or superimposed.

Polishes are distinguished mainly on the basis of surface brightness and smoothness, the presence or absence and types of pits in the surface, and, particularly for hide working tools, the degree of rounding of the edge. Variation in these characteristics allows the experienced analyst to distinguish between tools used on wood, shell, dry hide, fresh hide, plants, meat, and bone and antler (Keeley 1980; Yerkes 1983). Although Keeley (1980:42-49, 55-60) initially distinguished between polishes formed by antler and by bone working, more recent research (Vaughan 1985) has shown that these two materials produce the same traces. Both bone and antler working form two distinct polishes, one rough and developed by scraping and one smooth and developed by cutting. Keeley (1980), Vaughan (1985), and Yerkes (1983) illustrate experimental and archaeological examples of the known varieties of microwear polishes. Experimental plates employed for the present study illustrating unmodified chert, fresh hide polish, rough bone polish, meat polish, and wood polish, can be made available for comparative purposes.

POST-DEPOSITIONAL PROCESSES AND THE INTERPRETATION OF USE TRACES

Because the examination of alterations to the surface of a tool caused by use is the cornerstone of the method of microwear analysis used here, alterations of the surface caused by exposure on the surface of the ground for extended periods of time and by other processes can be a problem. Although, as Keeley (1980: 28-35) discusses, these alterations are difficult to mistake for use polishes because their appearance, and especially their distribution on an artifact, differ from those of a microwear polish, surface alterations caused by weathering can obscure and, in some cases, remove use polishes.

A variety of distinct chemical and physical processes can alter the surface of an artifact (see Keeley 1989:28-35; Levi-Sala 1986; Plisson 1983; Rottlander 1975, 1976; Shackley 1974; Stapert 1976). For the purposes of this report, four degrees of weathering, indicating the level of alteration, have been defined (cf. Shackley 1974):

1. Absent: the surface shows no alteration.

2. Light: the high points of the microtopography are bright, but the low points are not and the details of the microtopography are clear.

3. Moderate: both the high and low points of the topography are uniformly bright, but the details of the topography are still visible.

4. Severe: the entire surface of the artifact is bright and the topography is eroded; in extreme cases, the surface may be pitted.

Unfortunately, recent work by Plisson (1983) indicates that under certain conditions, some chemical solutions, particularly carbonates, and light tumbling in fine sediments can alter or obliterate use polishes without visibly affecting the rest of the artifact surface. Prolonged exposure to these processes will result in noticeable surface erosion, but Plisson's results have two important consequences. First, in some cases the absence of microwear polishes on an assemblage may not be the result of lack of use but of post-depositional conditions. Second, erosion of the edges before the rest of the surface implies that more visible natural alterations should start to form there before they form on the interior of an artifact exposed to the weathering agent. It is conceivable that these natural alterations might be mistaken for use polishes. This latter problem can be avoided by examining all edges of each artifact; traces which are present around the entire circumference of an artifact are not likely to be the results of use.

Obviously, surface exposure in the Mojave Desert subjects artifacts to abrasion by wind-borne sand and silt, undoubtedly accounting for much of the visible weathering on the study collection. There are also good *a priori* reasons for expecting the chemical processes just discussed to have affected this collection. Soils formed under arid conditions tend to be very poorly leached,

leading them to contain high concentrations of carbonates, particularly calcium carbonate. Although extremely high carbonate concentrations tend to occur as "lime layers" at varying depths form the surface, entire profiles of desert soils are generally calcareous (Thompson and Troeh 1973:37, 528-529) potentially destroying microwear polishes over time.

The appearance of surface weathering at high magnification is likely to be confused only with that of meat polish. However, weathering is almost always found over an artifact's entire surface and use polishes are restricted to the working edge. Light weathering generally poses few problems for the identification of meat polish. Moderate weathering makes it extremely difficult to see meat polish as it tends to even out differences in brightness between polished and unpolished portions of a tool. Other polishes can frequently still be identified on a moderately weathered artifact because they involve changes in a surface's appearance as well as its brightness, although such an identification is clearly somewhat less reliable than if the artifact were fresh.

Brighter polishes will still show up as more reflective areas even along a weathered edge, and the topographic changes which are particularly distinctive of the various polishes are unaltered by moderate weathering. This is especially true of plant and wood polishes, which create extremely smooth surfaces which retard some of the weathering processes. Keeley (1980:29), for instance, reports seeing polished portions of an edge pedestaled above the surrounding eroded surface of weathered implements. Severe weathering as defined here, however, makes any interpretation of use-traces impossible.

To summarize, although alterations of the surface of artifacts due to weathering are problems for microwear analysis, the severity of the problem varies with the degree of weathering and the type of observed polish. Meat polish is likely to be the most easily obscured trace of use, and analysis of even lightly weathered implements may misrepresent the frequency of tools actually used on meat. Other polishes will be more difficult to see with more developed weathering, but can still be discerned even when it is moderate, although their identification cannot be accepted as confidently as on less weathered pieces. The problems imposed by weathering can be

controlled in practice by carefully examining the entire surface of each artifact rather than studying only their edges, by searching carefully for other traces of use such as edge-rounding and striae when polish appears to be present on a weathered piece, and by applying a conservative standard in attributing microscopic traces to prehistoric use when those traces are found on weathered artifacts.

EXPERIMENTS WITH BASALT

It had been hoped that the analysis of use polishes could be extended to basalt, a raw material which has not been extensively studied in this context (but see Price-Beggerly 1976). However, this pilot experimental program produced no visible alterations of the surface of any used edge, although it did produce indistinct low-magnification edge damage and rounding. All of the experimental pieces were unmodified flakes struck from two blocks of basalt obtained from Fort Irwin. Edges, other than those being used, were ground to protect one's hands, and the experiments were conducted for 10 minutes of continuous use. This should be long enough to determine whether polishes will form. Keely (1980) for instance, illustrates how well-developed polishes form after five minutes of use and even after only one minute of scrubbing with a nylon toothbrush, although it is not always long enough for the polishes to be fully developed (Bamforth 1980, 1988).

The lack of results in these experiments was generally confirmed by N. Toth (personal communication) at the University of California at Berkeley, who has supervised an extensive experimental program. The only difference in Toth's results was that he found a very slight development of plant polish on one basalt tool after an hour of continuous use; these plant cutting experiments formed no polish at all after 10 minutes.

These experiments, however, did yield useful information. Unlike microcrystalline stone, basalt shows substantial differences in its usefulness for different tasks. Although it was quite effective, for instance, in cutting plants and soft wood, it was almost useless on harder wood. This suggests that many important tasks would have been difficult or impossible to perform with

basalt tools, particularly shaping wooden implements such as spear-throwers or dart shafts. This may have important implications for the shift noted in the Mohave Desert from Lake Mohave and Pinto period use of basalt for bifaces and microcrystalline stone for unifaces to later exclusive reliance on the latter material. Increased sedentism and residential group size in later periods, for instance, may have allowed people to rely only on higher-quality and more generally useful raw materials by increasing the amount of stone which could be stored and by reducing the frequency with which it had to be transported.

THE CONDITION OF THE COLLECTION

There are two classes of non-use alterations to the collection which could affect this analysis: the processes of natural weathering just discussed and the way the collection was handled during and after excavation. As the first of these is by far the most important, its effects will be assessed first. The data on which this section is based is summarized from Table 5-4 in a later section of this report.

The major types of weathering present on the artifacts appear to be those discussed in the preceding section. In addition, two artifacts recovered from the surface show an extensive development of orange desert varnish on one face, presumably that face which was in contact with the ground. This varnish has no effect on the utility of these artifacts for microwear analysis except where it extends all the way to their edges.

The dominant types of post-depositional alteration visible on the collection appear to be the result of wind abrasion and chemical weathering. Virtually every artifact in the collection shows some signs of these processes. As Table 5-1 indicates, the degree of weathering present on an artifact tends to decrease with the depth from the surface at which that artifact was recovered. Section 1a of Table 5-1 shows the frequencies of artifacts for each degree of weathering and 10 centimeter level. As the counts in this section are too small to compute any statistics, they are collapsed into section 1b; categories were combined here to divide the depth totals into three

Table 5-1: Frequencies of Artifacts from Nelson Wash by Degree of Weathering and Depth.

Section 1a:

	Depth						
Weathering	Surface	0-10	10-20	20-30	30-40	40-50	>50
Absent	0	0	0	0	1	1	0
Light	7	0	3	0	3	4	3
Moderate	16	3	3	4	4	1	1
Severe	12	1	0	2	1	1	0

Section 1b:

Weathering	Surface	0-30	>30	Total
Absent/light	7	3	12	22
Moderate/severe	28	13	8	49
Total	35	16	20	71

segments with counts as close to equal as possible and to divide the weathering totals into two between degree of weathering and depth (chi-square=13.4, df=2, $0.005>p>0.001$). As was discussed above, weathering can either obscure or remove polishes. Lacking detailed information on soil chemistry, rates of artifact burial, and the degree to which artifacts have moved within the deposits, the possibility that either of these problems exists must be assessed indirectly; the only direct evidence that parts of the study collection were definitely exposed to concentrations of some form of carbonate is the fact that a few of them reacted noticeably with the HCl they were cleaned in. There are two convenient means of assessing the scale of this problem for the collection as a whole.

The first is to examine the frequency of a particular type of microscopic trace on artifacts with increasing degrees of weathering. Because different types of traces have differing degrees of resistance to weathering (Plisson 1983), studying only one type should reveal any decrease in the information available from the collection which is caused by weathering. The trace should be present less frequently on more weathered implements.

Only one trace, that left by grinding the edges of artifacts during manufacture, is common enough in the collection for such an analysis. The appearance of this trace is described in a later section of this report. Table 5-2 shows the frequency of artifacts bearing traces of edge-grinding by degree of weathering, broken down into bifaces and unifaces. This division by artifact class was made because, as is discussed later, it is possible that bifaces were produced but rarely used at Nelson Wash and that unifaces were used but rarely produced there; as grinding is a production trace which is frequently removed by the last flakes struck from an artifact, lumping all artifacts together might obscure any pattern present. In this and the following table, a single biface made from quartz crystal which could not be examined under the microscope is excluded, decreasing the sample size from 72 to 71.

Although the counts in Table 5-2 are too low for statistical analysis, they do show the expected effects of weathering. With the exception of the two tools with no weathering, the proportion of artifacts showing no traces of grinding increases for both unifaces and bifaces with more pronounced post-depositional surface alterations.

The second means of assessing this problem is to examine the relationship between the degree of weathering on an artifact and the reliability of the inference drawn from its examination under the microscope. Table 5-3 shows the frequencies of implements classed as used, unused, possibly used, and uninterpretable by degree of weathering. If weathering obscures and removes traces of use, weathered implements should fall into the last three categories, and particularly the last two of them, more frequently than less weathered implements. This is clearly the case,

with the pattern being especially pronounced for the rates of possibly used and uninterpretable pieces.

These data therefore suggest that post-depositional processes have affected the potential of the Nelson Wash collection for detailed microwear analysis by removing some polishes and obscuring others. There are several means of controlling for this problem in interpreting the results of this analysis. The first is to note that although the analysis of the frequencies of artifacts showing traces of edge grinding suggested that such traces may have been present on more weathered artifacts but were removed from them, 66 percent of the moderately weathered bifaces still showed traces of grinding. This suggests that many use traces should also still be visible on artifacts with this degree of weathering.

Table 5-2: Frequencies by Degree of Weathering and Presence of Grinding Traces of Bifaces and Unifaces from Nelson Wash.

	Bifaces			Unifaces		
Weathering	Ground	Not Ground		Ground	Not Ground	
Absent	0	1		0	1	
Light	8	3	(27)[1]	5	4	(44)[2]
Moderate	9	4	(33)	2	18	(90)
Severe	1	2	(67)	0	14	(100)

[1]percent of bifaces with this degree of weathering and no grinding
[2]percent of unifaces with this degree of weathering and no grinding

Table 5-3: Frequency of Artifacts from Nelson Wash by Degree of Weathering and Reliability of Interpretation.

	Reliability			
Weathering	Used	Unused	Possibly Used	Uninterpretable
Absent	1	1	0	0
Light	4	13	3	0
Moderate	4	18	8	2
Severe	0	0	1	16

In addition, the overall effects of these processes can be predicted. As Plisson (1983:76) notes, meat and hide polishes are the most susceptible to chemical attack, wood is intermediate in resistance, and bone and antler polishes are the most resistant. Even when the polish is gone, though, hide working tools can often be recognized by their distinctly rounded edges which do not form under any other use. Keeley (1980:29) also notes that physical weathering tends to affect rougher areas of a surface and, by extension, rougher polishes first. It is more difficult for sand and silt grains to catch on smoother polishes such as those formed by use on plants and wood, and these polishes therefore resist abrasion longer. These considerations thus imply that meat-cutting traces should be most under-represented in the collection, with other uses under-represented to a lesser degree. Relative biases against traces other than those left by meat cannot be reliably assessed at present because physical and chemical weathering are resisted differently by the various polishes and the relative importance of the effects of these two processes on the study collection is unknown.

Auagmenting these natural processes, there is evidence in the collection for excavation or post-excavation alterations (cf. Gero 1978; Muto 1979; Schousboe 1977; Wylie 1975). Seven of the 72 artifacts (9.7%) bear edge damage scars which go through a weathered surface and expose a completely fresh surface beneath. One of these seven also has metal streaks on it which can

only have formed since it was recovered. These traces are unlikely to create serious problems here. The presence of some weathering on virtually every tool essentially ensures that post-recovery damage will expose visibly fresher stone than that elsewhere on the edge and so will be detectable. Were this not the case, though, such damage probably could not be distinguished from use damage and might affect interpretations, particularly those based only on low-magnification analysis.

RESULTS OF THE MICROWEAR ANALYSIS

The sample of artifacts analyzed here was chosen in two stages. In the first stage, 28 microcrystalline bifaces comprising approximately a 25% sample of the total recovered from the site were selected for analysis. This sample was chosen to emphasize subsurface material in order to minimize the likelihood that extensive weathering on the ground surface had destroyed the microtopography of the stone; only those surface artifacts with a minimum of macroscopic weathering were included in the sample. In the second stage, 44 microcrystalline unifaces were selected for analysis. Because of the relatively small number of subsurface artifacts of this type, this sample includes a higher percentage of weathered pieces than those in the first stage.

Table 5-4 summarizes the overall results of the analysis. Because many tools were too weathered for analysis or showed no traces of use, individual artifact descriptions are presented for only a portion of the study collection. The artifacts described include all those showing definite or possible traces of use and a few others with unusual features of some kind. Artifacts with accession number 174 were recovered from site 4-SBr-4963, artifacts with accession number 178 were recovered form 4-SBr-4966, artifacts with accession number 180 were recovered from 4-SBr-4968, and artifacts with accession number 440 were recovered from site 4-SBr-5267.

Descriptions of Selected Artifacts

174-139: The weathering on this implement is severe over the entire surface except in one large flake scar in the center of the left edge, where it is light. This probably reflects scavenging and

reworking of the piece considerably after it was first manufactured. No interpretation can be made of the severely weathered areas and no use traces are visible on the reworked area.

178-741: This tool shows well-developed fresh hide polish and the edge rounding which is unique to hide polish on its distal edge. This polish is most intense in the center of the edge and fades out to either side. It extends approximately one centimeter back from the edge on the ventral face and appears to be poorly developed on the dorsal face, although the weathering is somewhat more severe on the dorsal face. No edge damage which is definitely from use is present, but there are clear striae perpendicular to the edge. Part of the opposing, unworked edge of this tool bears traces of grinding. This is a hide scraper.

178-790: The left edge of this artifact is rounded and shows striae perpendicular to it. This edge is also brighter than the surrounding surface and has the characteristic roughness of hide polish, but the degree of weathering makes this identification tentative. This is a possible hide scraper.

178-1548: The right portion of the distal edge of this tool shows a polish wh. .h is very similar to Keeley's (1980:74-75, Plate 64) "atypical bone polish" formed by working dry bone which was 10 months old. This polish is fairly smooth and bright and is semi-continuous along the edge, being best developed on the high points of the microtopography. Narrow striae run perpendicular and at high angle to the edge. Edge damage due to use cannot be distinguished from that due to retouch. This is a probable bone scraper.

178-3254: The only potential use traces on this tool are a possibly greater degree of edge rounding and indistinct striae perpendicular to the edge on the ventral face of the proximal portion of the right edge. The surface is too bright to see if any polish is present. This is a possible hide scraper.

Table 5-4: Summary of Results of Microwear analysis of 72 Bifaces and Unifaces from Nelson Wash.

Artifact	Level	Weathering[1]	Used[2]	Described	Class[3]	Non-use Traces[4]
174- 18	surface	4	4	no	2	2
174-139	surface	4	4	yes	2	3
178-546	surface	2	2	no	2	1,3
178-556	surface	4	4	no	2	-
178-573	surface	4	4	no	1	-
178-741	surface	2	1	yes	2	1
178-790	surface	3	3	yes	2	-
178-815	surface	3	2	no	1	1
178-1548	surface	3	1	yes	2	-
178-1624	surface	3	2	no	2	-
178-2500	surface	4	4	no	2	-
178-3224	20-30	3	2	no	2	-
178-3254	20-30	3	3	yes	2	-
178-3427	0-10	4	4	no	2	-
178-3464	30-40	2	2	no	1	1,2
178-3465	0-10	3	4	yes	2	-
178-3493	60-70	2	2	no	2	1
178-3724	surface	3	2	no	2	2,5
178-3760	surface	2	2	no	2	1
178-3971	surface	5	4	yes	1	-
178-4306	surface	3	3	yes	2	2
178-4390	surface	2	1	yes	2	6
178-4381	surface	2	1	yes	2	-
178-4433	surface	3	2	no	1	-
178-4486	surface	3	2	no	1	1
178-4846	surface	3	2	no	2	6
178-4874	surface	4	4	no	2	-
178-5281	surface	4	4	no	1	1
178-5412	surface	3	2	no	1	1

Table 5-4: Continued.

Artifact	Level	Weathering[1]	Used[2]	Described	Class[3]	Non-use Traces[4]
178-5796	0-10	3	3	yes	2	1
178-5983	0-40	2	3	yes	1	-
178-5994	0-50	1	2	no	1	-
178-6071	0-50	3	2	no	2	-
178-6101	30-40	3	3	yes	2	-
178-6115	40-50	4	4	no	2	-
178-6281	30-40	3	3	yes	2	-
178-6377	20-30	4	4	no	2	-
178-6400	30-40	3	2	no	2	-
178-6728	10-20	2	2	no	1	1
178-6729	10-20	3	3	yes	1	1
178-6765	20-30	3	2	no	1	-
178-7034	10-20	3	2	no	1	1
178-7081	10-20	3	2	no	1	1
178-7110	10-20	2	2	no	1	-
178-7122	30-40	3	1	yes	2	-
178-7200	49 cm	2	2	no	1	1
178-7329	20-30	4	4	no	2	-
178-7424	50-60	3	2	no	1	1,2
178-7583	30-40	4	4	no	2	-
178-7589	40-50	2	2	no	1	1
178-7839	50 cm	2	3	yes	1	2
178-7910	10-20	2	2	no	1	1
178-7928	50-60	2	3	yes	2	-
178-8039	20-30	3	2	no	1	-
178-8064	40-50	2	2	no	1	1
178-8070	50-60	2	2	no	1	1
178-8153	0-3	3	2	no	2	-
178-8568	30-40	2	2	no	1	1,2
180-169	surface	4	4	no	1	-
180-187	surface	3	1	no	1	1
180-226	surface	3	1	yes	2	-
180-349	surface	4	4	no	2	-
180-382	surface	2	1	yes	2	-
180-507	surface	3	1	yes	2	4
180-554	surface	3	4	no	2	-

Table 5-4: Continued.

Artifact	Level	Weathering[1]	Used[2]	Described	Class[3]	Non-use Traces[4]
440- 22	surface	4	3	yes	2	-
440-155	surface	4	4	no	2	-
440-246	surface	4	4	no	2	-
440-356	surface	3	3	yes	1	1
440-429	surface	3	2	no	2	1
440-547	surface	2	2	no	2	1

[1]1=absent, 2=light, 3=moderate, 4=severe
[2]1=yes, 2=no, 3=possible, 4=unknown
[3]1=biface, 2=uniface
[4]1=grinding, 2=recent edge damage, 3=reworked, 4=orange bottom varnish, 5=metal streaks, 6=hammerstone smear

178-4306: All ridges and edges of this implement are eroded, but its distal edge shows striae perpendicular to the edge on the dorsal face. A possible scraper, worked material unknown.

178-4340: There is a hammerstone smear leading to a large flake scar on the proximal half of the right edge. The left edge of this tool shows bifacial fresh hide polish, best developed at the distal end, and striae at low to moderate angles to the edge. Edge damage takes the form of small, shallow scalar and steep scalar, large shallow step, and small shallow triangular scars semi-continuous along the working edge. The hide polish shows that this was used to cut hide; the edge damage is most probably from contact with bone and ligaments during this activity or subsequent relatively heavy butchering. This is a skinning knife.

178-4381: Three parts of this tool show relatively distinct wood polish. The two lateral edges show it at the very edge of the ventral face and extending farther back on the dorsal face. The striae on the right edge are perpendicular to it and on the left edge are at a high angle to it.

This second edge also shows large, deep, scalar scars scattered on this ventral face, while the first edge shows a few small and microscopic shallow scalar and step scars on its ventral face. The third polished area is the projection at the distal end of the tool, where wood polish is present on the high points. Striae in this area are perpendicular to the edge around the projection, indicating use as a drill. Edge damage due to use cannot be distinguished from that due to retouch in this area. This is a wood scraper and drill.

178-5796: Moderate weathering on this artifact makes any polishes which might be present unclear, but there are narrow striae perpendicular to the left edge. The edge damage on this edge is confined to a few shallow small and large scalar scars scattered along both faces, suggesting that the worked material was relatively soft. The retouched distal edge of this tool shows traces of grinding. This is probably a scraper.

178-5983: There are possible traces of fresh hide polish along the very edge of the striking platform of the flake, along with possible striae perpendicular to it. The biface from which this was struck may have been used to scrape hide.

178-6101: The only possible use trace on this tool is a distinctly greater degree of rounding on its distal edge than is present elsewhere; weathering makes a polish identification uncertain. If this rounding is the result of use, it would indicate use on hide. This tool is considered a probable hide working tool.

178-6281: There is a poorly-developed possible fresh hide polish along the left edge of this artifact. The polish is patchy and is most visible on the ventral face. There are also sharp striae perpendicular to the working edge in this area. Use damage, if present, cannot be distinguished from retouch. This tool is probably a hide scraper.

178-6729: The flat (possible ventral) surface of this artifact has been almost completely retouched, removing most of the edges which would have borne traces of use if any were present; there are no use traces on these edges. There is, though, possible fresh hide polish on one small remnant of the original edge. The polish is difficult to recognize on such a small

area, but this bit of edge is rounded and adjacent edges are not. This is a possible hide working tool which was retouched and then discarded before being reused.

178-7122: There are small patches of fairly bright, smooth polish scattered along the dorsal face of the left edge of this tool, particularly at the proximal end. These are associated with frequent striae perpendicular to the edge. There are a few microscopic shallow scalar and triangular scars and one large deep shallow step scar on the ventral face and more frequent large shallow scalar and step scars scattered on the dorsal face. The polish is similar to that produced by working either wood or antler and bone, but its patchiness in conjunction with the number of striae and degree of edge damage suggests the latter. This is a probable antler or bone scraper.

178-7129: Both lateral edges of this tool bear bifacial meat polish and patches of abrasion. There are also occasional striae at low to moderate angles to the edge. The edge damage present consists mainly of small and microscopic (with a few large) scalar and triangular shallow scars scattered semi-continuously on both faces of both edges. Half-moon scars are also relatively common. This is a knife used in heavy butchering, with meat polish formed by contact with flesh and abrasion and edge damage from occasional contact with more resistant bone and ligaments. The extent of the damage and abrasion suggests use on a fairly large animal.

178-7839: This artifact is an overshot flake which removed a substantial part of the edge of a biface. There are possible traces of meat polish on this edge along with sharp striae which run at a low angle to it. If it is present, edge damage from use cannot be distinguished from that produced during manufacture. The biface this was removed from was, tentatively, used to cut meat.

178-7928: There is no definite polish on this artifact, but on the high points of projects along its left edge there are fairly bright, smooth patches and striae parallel to the edge. This edge also shows frequent small to large shallow scalar and stepped scars on the dorsal face; these are superimposed on one another in projecting areas at either end of the edge. Damage scars are smaller and fewer on the ventral face and tend to be more common towards its proximal end. The distribution of the possible polish and the extent of the edge damage suggest use on a fairly

hard material, and the striae and edge damage indicate use for cutting. The most likely worked materials are antler or bone as most wood is soft enough to have left more distinct traces, but this is more a guess than an interpretation. A cutting tool, worked material unknown but probably very hard.

180-226: The distal edge of this tool shows clear fresh hide polish with striae and linear features perpendicular to the edge as well as pronounced edge rounding; this polish is macroscopic if the edge is examined closely. The polish is most extensive on the ventral face but is present on high points on the dorsal face several millimeters from the edge. Less pronounced traces are present on the proximal and right edges, but the polish is unclear; here, edge rounding is the most distinctive trace. This tool was used to scrape hide.

180-332: Most of the right edge of this tool shows clear fresh hide polish, best developed on the ventral face and more limited on the dorsal face. This is associated with short, sharp striae at moderate to high angles to the edge and distinct edge rounding. One section of the distal half of this edge appears to have been resharpened after the tool was used, as there is no polish directly on the edge of the dorsal face, limited polish on the ventral edge, and no edge rounding. There are clear traces of use on either side of this part of the edge. Use damage cannot be separated from retouch on this portion of the tool; on the proximal half of the used edge, there are large and small deep and shallow scalar scars semi-continuous on the dorsal face and scattered on the ventral face. The distribution of the polish and orientation of the striae suggest use removing tissue and flesh from fresh hide; hide scraping proper would produce striae perpendicular to the edge. The edge damage may indicate another use, but is the only evidence of it and so cannot be considered reliable.

180-507: Part of the left edge of this tool shows fresh hide polish, striae perpendicular to the edge, and edge rounding. This polish ends abruptly at a large flake scar on the proximal edge, suggesting that the rest of the edges have been resharpened. The rounding and polish are also truncated in place by small resharpening flakes. This is a hide scraper.

440-22: Weathering makes any polish which might have been present on this artifact impossible to see, but there are probable use striae on the dorsal face of the left edge perpendicular to the edge. This is a possible scraper.

440-356: There are no definite use traces on this artifact, but the left edge is rounded while the other edges are not. There is damage on this edge, but much of it truncates both the rounding and the surface weathering, exposing fresh stone and thus indicating that at least some of it is recent. This is an overshot flake which removed part of the edge of a biface, and there are possible traces of grinding on this edge. This artifact is possibly used, with edge rounding tentatively suggesting some form of hide working.

Discussion

Table 5-5 summarizes the interpretations of the tools showing traces of use. This table divides the totals into reliable and possible interpretations; the similar proportions of hide working tools of one kind or another in these two categories (five of the nine reliable interpretations and seven of 12 of the possible interpretations) are at least some evidence that the latter interpretations are useful.

This table shows a relatively diverse suite of tasks including carcass processing (skinning and butchering), hide preparation (hide scraping and fleshing), and manufacture or repair of some form of wood and bone or antler implements. Several cautions must be kept in mind in interpreting these data. First, the operation of the post-depositional processes discussed earlier have probably caused several classes of tools to be under-represented, particularly those bearing traces from cutting meat. Second, it is dangerous to assume that the association in an archaeological site of tools used for different tasks automatically implies that those tasks occurred together in that site (Binford 1977; Gramly 1980; Keeley 1982, 1984; Simek 1984).

In societies which heavily maintain and recycle tools, worn implements will tend to be discarded not in their locus of use but in the area where a new tool to take their place is acquired. This is particularly true of hafted tools; the stone working portion of a hafted tool is relatively

inexpensive in terms of manufacturing time, but producing most hafts requires substantial investments of time and energy (Keeley 1982). Replacing the stone components of hafted tools also takes time and is therefore most likely to occur when time is available, usually in a base camp. The wear traces on tools discarded in retooling areas thus indicate uses which may not have occurred at the site where they were replaced in their hafts.

Table 5-5: Tool Uses by Reliability of Inference.

	Reliability of Inference	
Tool Use	Reliable	Possible
Hide scraper	3	4
Hide flesher	1	0
Hide working, mode of use unknown	0	3
Skinning	1	0
Butchering	1	1
Wood working	1	0
Bone/antler working	1	1
Cutting, material unknown	1	0
Scraping, material unknown	0	3
Total	9	12

The Nelson Wash data can then be considered in light of three possible situations: (1) the association of tools used for different tasks implies the association of these tasks within the general site area; (2) the implication that the Nelson Wash sites were retooling locations, and; (3) a combination of these two factors. Given the small sample of artifacts studied here, there is no reasonable way to confidently choose between these three alternatives. However, the data can be considered from the perspective of each of them and general conclusions can be drawn.

Assuming that the tasks were associated, the major pattern which is evident is the numerical dominance of tools bearing traces of use related to processing animal products. The frequencies of tools used for these tasks are more meaningful when they are compared to the frequencies of tools used for similar purposes on the San Antonio Terrace, Vandenberg Air Force Base, Santa Barbara County, California (Bamforth 1983, 1986). Detailed analysis of collections from the San Antonio Terrace indicates that sites in the region are temporary hunting camps used by special task groups travelling out from major residential bases to procure meat. Table 5-6 shows the frequency of tools in the task-categories represented in the Nelson Wash collection from the Terrace and from the study collection.

The proportion of tools used to process animal products in both cases is extremely similar, 41% from the San Antonio Terrace sites and 43% from the Nelson Wash sites. However, the frequencies of the various specific tasks represented differ substantially. Table 5-7 shows the frequencies of tools used for skinning and butchering, hide preparation, and other tasks in the two collections. There is strong non-random patterning in this table (chi-square=13.6, df=2, $0.005 > p > 0.001$, Yule's Q=0.43) which is caused by the overrepresentation at Nelson Wash of tools used in hidepreparation and the overrepresentation on the San Antonio Terrace of tools used in skinning and butchering.

This suggests that the San Antonio Terrace sites tended to be the scene of mainly the earlier portions of carcass processing and that the Nelson Wash sites were the scene of essentially the full range of processing. Extensive hide preparation is more likely to occur in a residential base than in a temporary hunting camp, and this difference is consistent with the previous interpretation of the San Antonio Terrace sites as the later type of site. Analogous reasoning suggests that the Nelson Wash sites are residential bases. The likely underrepresentation of tools showing traces of meatcutting suggests that the total number of butchering tools in the study collection may be an underestimation and makes this interpretation somewhat tentative. However, the data presented in Table 5-7 supports ths interpretation identifying a higher number of working tools rather than meat cutting tools from the Nelson Wash Sites.

Table 5-6: Comparison of Tool Use in the Study Collection and the San Antonio Terrace, Vandenberg Air Force Base, California.

	Nelson Wash		San Antonio Terrace	
	%[a]	N	%[a]	N
Hide scraping	33.3	7	6.5	6
Hide fleshing	4.8	1	0.0	0
Skinning	4.8	1	18.5	17
Butchering	9.5	2	16.3	15
Wood-working	4.8	1	4.8	4
Bone/antler working	9.5	2	5.4	5

[a]percent of total used pieces: total for Nelson Wash = 23;
total for San Antonio Terrace = 92

Table 5-7: Frequencies of General Groups of Tool Uses from Nelson Wash and the San Antonio Terrace.

	Nelson Wash		San Antonio Terrace		
	Observed	Expected	Observed	Expected	Total
Skinning/Butchering	3	7.8	32	26.2	35
Hide Preparation	8	3.2	6	10.8	14
Other	3	2.8	9	9.2	12
Total	14		47		61

There is overwhelming support for the possibility that retooling was an important activity in the Nelson Wash area. The abundant lithic production debris which provides the clearest support is not the subject of this discussion, but results of this analysis are also relevant. Two aspects

of the information presented here are particularly relevant to this topic: traces of grinding on the edges of the artifacts and the relatively large number of unused pieces in the collection.

The edges of tools are frequently ground during production to strengthen the edge from which flakes are to be struck (Keeley 1974; Sheets 1973). This author's experiments have shown that microscopic traces from this process take the form of fairly bright, smooth, flat patches, with some similarities to hammerstone smears (Keeley 1980:28), associated with abrasion tracks and striae running at a variety of angles to the edge. These traces are found at and near the edges of the tools, usually on the high points, and are just as distinctive some distance from the edges as they are directly on them. This contrasts with use-polishes, which form directly on the edge and usually decrease in distinctiveness away from it. In several cases, these traces were present on unworked broken edges, as though the knapper had contemplated an attempt to salvage a production failure but had not actually done so.

In most cases, traces of grinding are struck off with the last series of flakes removed; their frequent presence on artifacts in the study collection thus suggests that many of them were rejected before they were completed. Only three of the 25 implements with grinding traces also bear traces of use. One of these is an overshot biface thinning flake with grinding on the remnant biface edge and use traces on one of the unworked lateral edges. The other two are unifaces with the grinding present on the edge opposite that which was used, probably to protect the hand of the tool user. The frequency of grinding traces on unused implements, then, indicates that a substantial amount of tool manufacture was carried out, suggesting that the replacement of worn tools was an important activity at the site. This would imply that the association between the various tasks indicated by the different microwear traces is the result of retooling rather than of *in situ* tool use. Like the previous possibility, frequent retooling suggests that the Nelson Wash sites are residential bases.

There are, however, interesting differences between the grinding frequencies and use on bifaces and unifaces, the two basic classes of tools recognized here, and these differences have some relevance to this issue. Table 5-8 shows the frequency of ground and unground tools and Table 5-9 the frequencies of use in these two classes. The unifaces clearly show traces of grinding less

frequently (chi-square=17.8, df=1, $0.001 > p$, phi=0.50) and traces of use more frequently (chi-square=9.6, df=1, $0.005 > p > 0.001$, phi=-0.43) than the bifaces.

These differences can be interpreted by considering the difference between hafted and hand-held tools. Unfortunately, microscopic traces related to these different modes of prehension are relatively rare and difficult to recognize (cf. Keeley 1982, 1984); the condition of most of the collection precludes reliably recognizing them, making this section of the discussion somewhat speculative. The only data relevant to these differences are the differences in the forms of the artifacts examined.

In general, it is likely that bifaces were hafted implements and that unifaces could be hafted or unhafted. The grinding noted on two of the used unifaces (see above) is relatively good evidence that they, and probably other similar implements, were hand-held, but the relatively small size and fairly regular shape of some of the other unifaces is more compatible with use in a haft than without one. It is thus reasonable to infer that most or all of the bifaces were intended for use in hafts and that the unifaces were used both in hafts and hand-held. As was previously argued, it is likely that hafted tools tend to be discarded in central retooling areas and unhafted tools tend to be discarded in or near the place where they wear out. This thus suggests that the bifaces were largely produced to retool implements used both on and off-site and that unifaces were produced both for immediate on-site use and to retool worn hafted implements, supporting the third possibility noted earlier.

In most situations, of course, this third possibility will be correct: particularly in residential bases, both retooling and *in situ* tool use will obviously be necessary tasks. Keeley (1984) discusses an approach to the problem of distinguishing between tools used and discarded on-site and tools used elsewhere and simply replaced and discarded on-site. Unfortunately, making such a distinction reliably requires a much larger collection than that which is available here. Despite this, the patterns discussed here tend to support the interpretation that the Nelson Wash sites are residential bases.

Table 5-8: Frequencies of Bifaces and Unifaces With and Without Traces of Edge Grinding.

	Ground		Not Ground		
	Observed	Expected	Observed	Expected	Total
Biface	18	9.7	10	18.3	28
Uniface	7	15.3	37	28.7	44
Total	25		47		72

Evidence for Possible Scavenging of Artifacts

One of the artifacts (174-139) shows evidence of reworking probably occurring some time after it was discarded. The degree of weathering on this piece varies substantially with the least weathered portions isolated in a large flake scar. It can be difficult to discern the exact boundaries of traces like this and this less weathered area may not correspond perfectly to the edges of the flake scar, but this pattern may indicate reoccupation of the site and scavenging of the study collection over a relatively long period of time.

Table 5-9: Frequencies of Reliably and Possibly Used and Reliably Unused Bifaces and Unifaces.

	Used		Unused		
	Observed	Expected	Observed	Expected	Total
Biface	4	9.5	20	14.5	24
Uniface	17	11.5	12	28.7	29
Total	21		32		53

CONCLUSIONS

Although this study has produced useful information, its results must be interpreted with caution. Analysis of the probable effects of post-depositional forces on the condition of the study collection indicates that physical and chemical processes have probably removed and obscured the microscopic traces of use which may have been present on at least some of the analyzed artifacts. This not only reduces the sample size thus providing reliable data on prehistoric tool uses, but, probably biases the relative proportions of tools used for certain tasks, particularly reducing the number of implements showing traces of meat polish.

With this in mind, three possible explanations for the presence of the used pieces in the collection were considered: (1) the tools were discarded after *in situ* use; (2) they were discarded when replaced in their hafts, and; (3) that both of these activities occurred. The sample of used tools found here is too small to reliably choose between these three alternatives, but common sense and certain aspects of the available data tend to support the latter. Regardless of which of the three is correct, the analysis suggests that the sites from which the study collection was recovered were residential bases and not temporary, task-specific camps, although other sources of information and a larger sample of used pieces are needed to make this interpretation with confidence. Even so, the analyzed implements suggest the functionality of microwear analysis as applied for this analysis. Microwear polishes were recognized on the study collection yielding valuable information on tool uses at the sites. The ability of this analytic method to derive such information from even a relatively weathered collection of artifacts is ample testimony to its power and wide applicability.

CHAPTER 6 - FAUNA AT NELSON WASH

ANALYSIS OF FAUNAL REMAINS FROM SITE 4-SBr-4966 by Charles L. Douglas

Introduction and Discussion of 4-SBr-4966

Site 4-SBr-4966 is one of the more important sites excavated on Fort Irwin, because it was occupied during the Pinto Period, a cultural period poorly understood for the Great Basin. Any substantive information from this site could be extremely valuable, both for enhancement of knowledge about that cultural period, and for the development of general theory about early desert cultures.

The site yielded 1611 bones representing 17 taxa. Bones and fragments were identified to the most precise taxon using my personal research reference research specimens. Of the 1611 bones and fragments, 898 were identifiable to genus or species; fragments were assigned to ordinal groupings (eg. *Rodentia, Artiodactyla*) on the basis of size and wall thickness. When thin-walled fragments could not be assigned to either *Rodentia* or *Lagomorpha*, they were placed under *Rodentia/Lagomorpha*. Thick-walled fragments were placed under *Artiodactyla*. Minute fragments that could have come from any number of taxa were placed under *Mammalia*. The more precise the identification, the more valuable the data for ethnozoological purposes.

Table 6-1 details bone counts from various proveniences in 4-SBr-4966. Generallu, faunal materials were most abundant from 10 to 70 cm, although various genera had individual concentrations as is shown in Table 6-2.

Ninety-three percent of the Tortoise (*Gopherus agassizi*) shell and bones were concentrated from 0 to 40 cm (Table 6-1); these proveniences contained 53% of the total bone materials. The majority (93%) of tortoise bone was found in Locus E; Locus NL* had the second highest concentration (5%), whereas other loci contained almost no tortoise bone. The reasons for this are totally unclear.

Table 6-1: Summary of Numbers of Bones by Provenience (All Loci)

Fauna	Depth (cm)												
	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110-120	Totals
Snake	-	-	1	2	-	-	-	1	-	-	-	-	4
Lizard	3	2	2	5	3	-	-	-	-	-	-	-	15
Phrynosoma platyrhinos	-	-	-	2	1	-	-	-	-	-	-	-	3
Gopherus	38	213	111	71	12	16	3	1	-	-	-	-	465
Mammalia	2	2	-	2	1	-	2	-	-	-	-	-	9
Rodentia/Lagomorpha	15	31	93	110	121	127	31	13	4	2	1	-	548
Lagomorpha	5	5	8	11	4	13	-	5	3	2	-	-	56
Lepus	4	1	8	14	56	18	29	21	-	-	8	1	160
Syvilagus	-	8	9	29	20	22	6	5	1	11	-	-	111
Rodentia	1	1	7	9	8	1	1	-	1	-	-	2	31
Ammospermophilus	-	-	-	-	1	2	-	-	-	-	-	-	3

Table 6-1: Summary of Numbers of Bones by Provenience (All Loci) - Continued

Fauna	Depth (cm)													
	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110-120		Totals
Perognathus	-	-	-	2	-	-	72	-	11	-	-	-		85
Dipodomys	-	1	-	-	-	31	1	-	-	-	-	-		33
Neotoma	-	-	-	1	-	-	10	-	-	-	13	12		36
Thomomys	-	1	-	1	-	-	-	-	-	-	-	-		2
Artiodactyla	-	-	7	7	5	1	2	1	-	-	-	-		23
Unknown/*Aves*	2/1	1/3	0/1	2/0	7/2	1/0	2/0	-	-	-	-	-		15/7
Totals	71	269	246	266	245	235	159	47	20	16	22	22	15	1606

Table 6-2: Percentage Occurrence, by Provenience, of Bones from Major Taxa in 4-SBr-4966. Major Concentrations in Each Taxon Are Underlined for Emphasis

Fauna	Depth (cm) 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Lizard	4	1	8	2	3	1	0	0
Tortoise	57	80	45	27	5	7	2	2
Rodentia/ Lagomorpha	22	12	38	42	51	54	20	28
Lagomorpha	7	2	3	4	2	6	0	11
Lepus	6	4	3	5	24	7	19	46
Sylvilagus	0	3	4	11	9	9	4	11
Rodentia	1	1	3	5	4	15	54	0
Artiodactyla	0	0	3	3	2	4	1	2
Aves	1	1	.4	0	1	0	0	0
Total No.	67	266	246	261	235	234	155	46

Leporids (hares and rabbits) comprised 20% of the total bone assemblage. The largest concentration (85%) of rabbit (*Sylvilagus sp.*) and jackrabbit (*Lepus californicus*) bones occurred from depths of 20 to 80 cm (Tables 6-2 and 6-4). Bone distributions from both genera of were similar (Tables 6-1 and 6-2), although there were more *Lepus* bones (160) than there were of *Sylvilagus* (111). Small bone fragments, many of which are probably from leporids, were distributed througout all proveniences, with a concentration from 20 to 60 cm *Lepus* bones were most abundant in proveniences from 30 to 80 cm, although they occurred in all but two proveniences (Table 6-1).

Rodent bones were clustered from 50 to 70 cm (Tables 6-1 and 6-2). This distribution, however, was a sampling artifact attributed to the presence of several partial skeletons of *Perognathus* and one of *Dipodomys*. Rodents apparently were not utilized extensively by the inhabitants of this site; rodent bones comprised 12% of the overall assemblage, but this number is inflated because of the partial skeletons mentioned above. Few individuals were represented.

Artiodactyl bones were scarce, represented only 1.5% of the assemplage. The low number of artiodactyl bones from a site thought to represent the Pinto culture is anomalous, and will be discussed further when this site is compared with 4-SBr-4562, another Pinto site on Fort Irwin.

Charred bones were numerous throughout the proveniences. Charred bones are indicated by an asterisk on summary listings of fauna for each locus, and for bones in each provenience (Tables 6-5, 6-6, 6-7, and, 6-8).

Table 6-2 shows the percentage occurrence, by provenience, of bones from major taxa in 4-SBr-4966. The proveniences below 80 cm were not considered because of small sample size. It is noteworthy that major taxa tend to be distributed mostly in upper or lower proveniences. Tortoise is distributed largely in the upper proveniences (0 to 40 cm), whereas leporids and rodents are concentrated in the lower proveniences. Artiodactyl bones are not well represented, but appear to be localized in proveniences 20 cm and lower. Small fragments are present in all proveniences, with a slight concentration in the middle proveniences.

Table 6-3: Comparison of Numbers and Percentages of Bones from Major Taxa Occurring in 4-SBr-4966 and 4-SBr-4562

Fauna	4966 No. Bones	4966 % Bones	4562 No. Bones	4562 % Bones
Snake	4	.2	1	.1
Lizard	22	1.4	1	.1
Tortoise	465	29	1	.1
Rodentia/ Lagomorpha	548	35	413	45
Leporidae	327	21	106	11
Rodentia	190	12	2	.2
Artiodactyl	23	2	399	43
Aves	7	.4	0	0
Total Bones	1586			923

Table 6-4: Percentages of Total Bones within Each Taxon, Shown by Provenience of Occurrence 4-SBr-4966. Only Major Taxa Are Shown. Major Concentrations in Each Taxon Are Underlined.

Fauna	Depth (cm)							
	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Tortoise	8	46	24	15	3	3	1	1
Rodentia/ Lagomorpha	3	6	17	20	22	23	6	2
Lagomorpha	9	9	14	20	7	23	0	9
Lepus	3	1	5	9	35	11	18	13
Sylvilagus	0	7	8	26	13	20	5	5
Rodentia	1	2	4	7	5	18	44	3
Artiodactyl	0	0	30	30	22	4	8	4

Table 6-4 presents similar information, but based on the percentage of bones within a taxon, as they were distributed by provenience. The major distributional patterns remains the same, except that the major concentration of artiodactyls appears to shift towards the upper proveniences (20 to 50 cm). This is probably due to the small sample size of bones in the taxon, and is not significant. It appears that tortoise became more important in the upper proveniences at about the time leporids were waning in numbers of bones deposited. Small fragments (*Rodentia/Lagomorpha*) appear to follow the distribution of *Lagomorpha* fragments, which is not surprising.

Comparison of Sites 4-SBr-4966 and 4-SBr-4562

Table 6-3 shows numbers and percentages of bones comprising major taxa in two Pinto Period sites from Fort Irwin. Small fragments of thin-walled bones (*Rodentia/Lagomorpha*) comprised the largest single grouping in both sites. This is not surprising, since such fragments are common in most desert sites.

In 4-SBr-4966, desert tortoise and leporids had the largest percentage of identifiable bones; whereas, in 4-SBr-4562, artiodactyls and leporids were the two most abundant taxa. In both sites rabbits and jackrabbits had the largest numbers of identifiable bones of any taxa. In part this could be an artifact of bone size. Rabbits, being a relatively small animal, did not present the same processing and transporting problems deer or bighorn sheep did. Rabbits probably were cooked more or less intact; whereas, artiodactyls probably were dismembered and shared with others before cooking. All bones of an individual rabbit probably tended to be disposed of in one site area; whereas, bones of an artiodactyl probably were more dispersed.

It is noteworthy that jackrabbit bones were more abundant in each site than were bones of cottontails. Site 4-SBr-4562 had 52 *Lepus* and 22 *Sylvilagus* bones; whereas, 4-SBr-4966 had 55 *Lepus* and 4 *Sylvilagus* bones. This suggests that leporids were probably were harvested by nets, since jackrabbits are more susceptible to being driven into nets than are cottontails. *Leporid* bones were a more important element of the 4-SBr-4996 assemblage (21%) of than they were in 4-SBr-4562 (11%). This is probably related to the relative importance of artiodactyl bones in 4-SBr-4562 (43%).

Ethnographically, desert tortoises were roasted in a fire pit prior to consumption (Fowler 1986:88). This practice ultimately led to shell fragmentation during the food preparation stage (after roasting). Because of the special construction of tortoise shell, even minute fragments are identifiable. This could lead to an overestimation of the importance of tortoise, when based on numbers of fragments. Unfortunately, tortoise limb bones are less commonly found precluding assignment of a meaningful MNI.

Artiodactyls are generally represented by long bone fragments less than an inch in length. Partially intact artiodactyl bones, or even articulating ends, are extremely rare in Fort Irwin sites suggesting that bones were smashed for marrow extraction. The presence of worked bone is also rare. There is a paucity of awls made from split metapodials, or punches or scrapers made on an articulating end of long bone, as is common in other western sites. Indeed, very few implements or incised fragments were recovered.

The leading distinction between the two faunal assemblages can be attributed to dietary practices. Inhabitants of 4-SBr-4562 relied on artiodactyls as a supplement to rabbits, which were a staple food item. This intersite difference probably reflects locational differences between sites. Site 4-SBr-4966 was close to a major drainage at a lower elevation, which would have been a suitable habitat for desert tortoises. Site 4-SBr-4562 was closer to mountain ranges known to have supported desert bighorn in historic times. This hypothesis of site location affecting faunal selection must be examined more closely, since we know from historic accounts that any mountains within the Fort Irwin area probably were not considered by the aboriginal inhabitants to be too far to travel for harvesting seasonal food items, or for hunting. Therefore, intersite differences in faunal selection should be examined on a temporal and spatial basis. It is possible that hunting or gathering specializations developed as human populations increased, or as the area became progressively more arid.

Comparison of Loci in 4-SBr-4966

Tables 6-5 through 6-9 summarize numbers of bones found in various proveniences of the loci within 4-SBr-4966. Several striking differences between faunal remains in different loci are apparent, and probably not the result of sample size.

Locus E had the largest number of bones, but also contained almost all of the tortoise shell from the site. Interestingly, 98% (458 specimens) of the tortoise shell recovered from the site had evidenc of charring. Extrapolation of ethnographic studies (NAH p88) strongly suggests prehistoric tortoise preparation was similiar through historic times.

The ratio of jackrabbit to cottontail bones was 14:1 for Locus E. Locus G contained very few tortoise bones, and had a jackrabbit-cottontail ratio of 1:3. Locus G also contained 39% of the artiodactyl bones from the site. Location may have influenced the jackrabbit-cottontail ratios. Locus NL had a jackrabbit-cottontail ratio of 1.5:1, whereas Locus H had a ratio of 4:1, but a small sample size. Variation in the jackrabbit-cottontail ratio is probably due to chance in all but Locus E. Selection appears to have been operative, and to have caused wide divergence from the overall site jackrabbit-cottontail ratio of 1.4:1.

Table 6-5: Locus E Summary, 4-SBr-4966 (*denotes charring)

Fauna	Depth (cm)								
	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	Totals
Snake	-	-	-	1	-	-	-	-	1
Lizard	3	2	-	1	4	1	-	-	11
Gopherus	31*	211*	108*	69*	6*	4*	3*	1	433
Mammalia	1	1	-	-	-	-	1	-	3
Rodentia/ Lagomorpha	10	12*	25*	30*	22*	9*	10*	7	125
Lagomorpha	3	2	3	1	2	8	-	5	24
Lepus	-	-	6	3	5	-	22	19	55
Sylvilagus	-	-	-	2	-	-	2	-	4
Rodentia	-	-	2	-	3	-	-	-	5
Ammospermophilus	-	-	-	-	1	2	-	-	3
Perognathus	-	-	-	1	-	-	-	-	1
Dipodomys		-	-	-	-	-	1	-	1
Neotoma	-	-	-	1	-	-	-	-	1
Artiodactyla	-	-	1	1	-	-	-	-	2
Unknown/*Aves*	0/1	0/1	0/1*	-	0/1	1*/0	-	-	1/4
Totals	49	229	146	110	44	25	39	32	674

Table 6-6: Summary Locus G, 4-SBr-4966 (*denotes charring)

Fauna	Depth (cm) 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	Totals
Lizard	-	-	2	-	-	-	-	-	-	-	2
Gopherus	5*	-	3*	-	-	-	-	-	-	-	8
Mammalia	-	1	-	1	1	-	1	-	-	-	4
Rodentia/Lagomorphl		10	52*	52*	32*	13*	10	1	3	1	174
Lagomorpha	2	3	-	-	1	3	-	-	3	1	13
Lepus	-	-	1	7	2	6	4	2	-	-	22
Sylvilagus	-	2	6	22	1	7	2	5	1	11	57
Rodentia	-	-	4	1	3	-	-	-	-	-	8
Perognathus	-	-	-	-	-	-	72	-	11	-	83
Neotoma	-	-	-	-	-	-	10	-	-	-	10
Artiodactyla	-	-	6*	1	3	1	-	1	-	-	12
Unknown/*Aves*		0/1			2/1		2/0			1/0	5/2
Totals	8	17	74	84	47	30	101	9	18	13	400

Table 6-7: Summary Locus NL, 4-SBr-4966 (*denotes charring)

Fauna	Depth (cm) 0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	Totals
Snake	-	-	-	-	2	-	-	1	-	-	-	3
Lizard	-	-	-	3	1	2	-	-	-	-	-	6
Phrynosoma platyrhinos	-	-	-	2	1	-	-	-	-	-	-	3
Gopherus	-	2*	-	2	6*	12*	-	-	-	-	-	22
Mammalia	1	-	-	-	-	-	-	-	-	-	-	1
Rodentia/ Lagomorpha	3*	9	16*	26*	66*	102*	11*	5	1	1	1	241
Lagomorpha	-	-	3	8	1*	2	-	-	-	-	-	14
Lepus	-	1	1	4	49*	12*	3*	-	-	-	-	70
Sylvilagus	-	3	3*	5*	19	15	2	-	-	-	-	47
Rodentia	-	-	1	8	2	1	1	-	1	-	-	14
Perognathus	-	-	-	1		-	-	-	-	-	-	1

Table 6-7: Summary Locus NL, 4-SBr-4966 (*denotes charring) - Continued

Fauna	Depth (cm)											
	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	Totals
Dipodomys	-	-	-	-	31	-	-	-	-	-	-	31
Artiodactyla	-	-	-	5*	2*	-	2	-	-	-	-	9
Unknown/*Aves*	1/0	0/1	-	2/0	5/0	-	-	-	-	-	-	8/1
Totals	5	17	24	66	185	146	19	6	2	1	1	472

Table 6-8: Summary Locus H, 4-SBr-4966 (*denotes charring)

Fauna	Depth (cm) 10-20	20-30	30-40	40-50	50-60	90-100	100-110	110-120	Totals
Rodentia/ Lagomorpha	-	-	2	1	3	-	-	-	6
Lagomorpha	-	2*	-	-	-	1	-	-	3
Lepus	-	-	2	-	-	-	8	1	11
Sylvilagus	3	-	-	-	-	-	-	-	3
Rodentia	1	-	-	-	-	-	-	2	3
Dipodomys	1	-	-	-	-	-	-	-	1
Neotoma	-	-	-	-	-	-	13	12	25
Thomomys	-	-	1	-	-	-	-	-	1
Totals	5	2	5	1	3	1	21	15	53

Table 6-9: Summary Loci A, B, D, and F

Fauna	Depth (cm)				
	Locus A 0-10	Locus B Surface	Locus D 10-20	Locus F 30-40	Totals
Gopherus	-	2	-	-	2
Mammalia	-	-	-	1	1
Rodentia/ Lagomorpha	1	-	-	-	1
Lepus	-	4	-	-	4
Rodentia	1	-	-	-	1
Unknown	1		1		2
Totals	3	6	1	1	11

MODERN FAUNA by Jonathan Kent

Nelson Wash faunal resources are difficult to determine with accuracy. The paucity of pertinent biological surveys for this region combined with recent disturbances make any inventory of species somewhat suspect.

For example, there are no indigenous artiodactlys reported for Nelson Wash today, and yet artiodactyl remains formed a significant portion of the faunal assemblages recovered archaeologically. The reasons for this discrepancy and others like it are varied but are likely to include range plant (pasturage) destruction, escape route disturbance, climatic change, soil erosion, and others, either alone or in combination.

Another factor to be taken into account when attempting to portray the fauna of Nelson Wash, is the lack of localized, or on-site, springs. The closest spring, No Name Spring, is more than 11 km to the northeast and Garlic Spring is more than 15 km to the southeast. There are potential springs areas, however, that have not been surveyed to the west of the project area. Even so, these spring resources would be more than 10 km from the Nelson Wash site areas. This great distance implies that animals adapted to localized spring resources would not likely be found in Nelson Wash sites unless imported there by some agent, most likely human.

As previously stated, very few direct observations have been published on the fauna of Fort Irwin, let alone the Nelson Wash area. A study designed to document LANDSAT vegetation and to identify avian (bird) species on the fort was conducted in March, 1984. The study (U. S. Army Environmental Hygiene Agency 1984) lists numerous bird species for desert areas of the Fort and frequencies of sightings. Birds were also listed for springs, the cantonment area, and wastewater treatment facilities, but these latter observations are not included in this discussion of the Nelson Wash project area. Table 6-10 lists these avion species (1984: G-1 to G-3).

Table 6-10: Avian Species in Desert Environments at Fort Irwin (after U.S. Army Environmental Hygiene Agency 1984).

Common Name	Scientific Name	Frequency[1]
Lesser Nighthawk	*Chordeiles acutipennis*	U
Killdeer	*Charadrius vociferus*	U
Roadrunner	*Geococcyx californianus*	0
American Kestrel	*Falco sparverius*	C
Prairie Falcon	*Falco mexicanus*	U
Red-tailed Hawk	*Buteo jamaicensis*	U
Turkey Vulture	*Cathartes aura*	O
Chukar[2]	*Alectoris graeca*	C
Gambel's Quail	*Lophortyx gambelii*	O
American Robin	*Turdus migratorius*	O
Common Raven	*Corvus corax*	A
Lesser Goldfinch	*Spinus psaltria*	O
Horned Lark	*Uremophilia alpestris*	A
House Finch	*Carpodacus mexicanus*	O
Loggerhead Shrike	*Lanius ludovicianus*	C
Northern Mockingbird	*Mimus polygottos*	O
Say's Phoebe	*Sayornis saya*	C
Ruby-crowned Kinglet	*Regulus calendula*	O
Black-throated Sparrow	*Amphispiza bilineata*	C
Brewer's Sparrow	*Spizella breweri*	O
Sage Sparrow	*Amphispiza belli*	U
Savannah Sparrow[3]	*Passereulus sandwichensis*	O
Vesper Sparrow	*Pooectes gramineus*	O
Rough-winged Swallow	*Stelgidopteryx ruficollis*	O
LeCont's Thrasher	*Toxostoma lecontei*	O
Sage Thrasher	*Oreoscoptes montanus*	U
Verdin	*Auriparus Flaviceps*	C
Western Meadowlark	*Sturnella neglecta*	O
Rock Wren	*Salpinctes obsoletus*	C

[1] Note: the following codes are presented in the 1984 study

O = Occasional--one or two individuals seen two or less times during survey.
U = Uncommon--a few individuals seen a few times per week.
C = Common--at least one individual seen between daily and every other day.
A = Abundant--a number of individuals seen several times each day.

[2] Introduced during historic times.

[3] Dark form.

An inventory was conducted of avian fauna from the China Lake Naval Weapons Center (NWC), an area adjacent to Fort Irwin and sharing many similar environmental features, but which is somewhat more mesic. The majority of the birds listed in Table 6-10 are residents of the NWC, i.e., they are year-round residents. Exceptions are the Lesser Goldfinch (*Spinus psaltria*), a summer visitor (present in the summer but not know to breed in the area); the Ruby-crowned Kinglet (*Regulls calendula*), Turkey Vulture (*Cathartes aura*), and American Robin (*Turdus migratorius*), all winter visitants (present during intermigratory fall and/or winter); the Lesser Nighthawk (*Chordeiles acutipennis*), a summer resident (present during spring and summer, usually nesting in the area); the Savannah Sparrow (*Passerculus sanwichensis*) and Rough-winged Swallow (*Stelgidopteryx rugicollis*), migrants (species seen during spring and fall migration periods); and the Vesper Sparrow (*Pooectes gramineus*), a vagrant (occasionally appears outside of its normal distribution or off its normal migration route). The Army's sighting of the Vesper Sparrow on Fort Irwin tends to confirm the presumption of this species' presence in the area.

Any or all of the birds in Table 6-10 might have been incorporated into the diet of the prehistoric inhabitants of Fort Irwin. Birds that are either winter or summer migrants may provide evidence of seasonal utilization of a site as well. Bean and Smith (1978:570-571) report that a variety of small birds were eaten by the Serrano, quail being "...the most important and desirable game bird."

As mentioned earlier, there are no formal census surveys for Nelson Wash or Fort Irwin fauna. During the 1982 Gallant Eagle survey (Robarchek et al. 1983:9), a variety of animals were actually observed. The report covered sightings at springs, spring areas and Nelson Wash; however, the sightings were not differentiated by area. Therefore, a description of Nelson Wash fauna must be questioned. Nevertheless, for sustenance, prehistoric hunter-gatherers would have had needed a water source nearby. Either they went to distant (see above) springs to get water, in which case they would have encountered these animals, or they had an as yet undocumented

(perhaps relict) source of water nearby, in which case such fauna might have been in the area. These sightings are the only published record of non-avian animals observed on Fort Irwin (Table 6-11).

Table 6-11: Fauna Sighted on Fort Irwin During Gallant Eagle Survey (after Robarchek et al. 1984:8-9).

Common Name	Scientific Name
Coyote	*Canis latrans*
Packrat (Desert Woodrat)	*Neotoma spp.*
Jackrabbit (Black-tailed Hare)	*Lepus californicus*
Cottontail Rabbit	*Sylvilagus audubonii*
Bobcat	*Felis rufus*

Table 6-12: Fauna Likely to be Found in or Near Nelson Wash, Fort Irwin.

Common Name	Scientific Name
<u>Reptiles</u>	
Desert Tortoise	*Gopherus agassizi*
Banded Gecko	*Coleonyx variegatus*
Zebra-tailed Lizard	*Callisaurus draconoides*
Collared Lizard	*Crotaphytus collaris*
Leopard Lizard	*Crotaphytus wislizenii*
Desert Iguana	*Dipsosaurus dorsalis*
Desert Horned Lizard	*Phrynosoma platyrhinos*
Chuckwalla	*Gauromalus obesus*
Desert Spiny Lizard	*Sceloporus magister*
Side-blotched Lizard	*Uta Stansburiana*
Western Whiptail Lizard	*Cnemidophorus tigris*
Sidewinder	*Crotalus cerastes*

Table 6-12: Continued.

Common Name	Scientific Name
Reptiles	
Mojave Rattlesnake	*Crotalus scutulatus*
Coachwhip	*Masticophis flagellum*
Spotted Leaf-nosed Snake	*Phillorhynchus decurtatus*
Gopher Snake	*Pituophis metanoleucus*
Common Kingsnake	*Lampropeltis getulus*
Long-nosed Snake	*Rhinocheilus leconti*
Shovel-nosed Snake	*Chionactur occipitalis*
Rosy Boa	*Lichanura Trivirgata*
Rodents	
Chisel-toothed Kangoroo Rat	*Dipodymys microps*
Merriam's Kangaroo Rat	*Dipodymys merriami*
Desert Kangaroo Rat	*Dipodymys deserti*
Pocket Mouse	*Perognathus longimembris*
Long-tailed Pocket Mouse	*Perognathus formosus*
Deer Mouse	*Peromyscus maniculatus*
Canyon Mouse	*Peromyscus crinitus*
Brush Mouse	*Peromyscus boylii*
Desert Pocket Mouse	*Peromyscus penicillatus*
White-footed Mouse (Cactus Mouse)	*Peromyscus eremicus*
Meadow Mouse	*Microtus californicus*
Pocket Gopher	*Thomomys bottae*
Desert Woodrat	*Neotoma lepida*
Mohave Ground Squirrel	*Citellus mohavensis*
Round-tailed Ground Squirrel	*Citellus teretacaudus*
Antelope Ground Squirrel	*Spermophilus/Ammospermophilus leucurus*
Other Mammals	
Kit Fox	*Vulpes macrotus*
Badger	*Taxidea taxus*
Bats	order Chiroptera
Mule Deer	*Odocoileus hemionus*
Desert Bighorn Sheep	*Ovis canadensis nelsoni*
Antelope	*Antilocapra americana*
Feral burro[1]	*Equus asnus*

[1] Introduced during historic times.

OTHER FAUNA

The published literature on Fort Irwin fauna is incomplete. There are no published records of small animal fauna including rodents, lizards, snakes, and other reptiles, yet these are surely present. In compiling observations verbally communicated by Fort Irwin Archaeological Project staff, a variety of published and unpublished reports on the Fort and from nearby areas with a similar environment, we may add the species in Table 6-12 to the list of present-day fauna (Coombs and Greenwood 1982; Reynolds and Shaw 1981; C. Douglas, D. Ferraro, D. Jenkins, J. Moriarty IV, K. Bergin, and C. Warren, personal communication).

Insects were also sighted by project personnel and are only mentioned because of Steward's remark (1938:34) that "even insects were sometimes of great importance" in Shoshonean subsistence. Grasshoppers have been sighted and could have been an important aboriginal food source. Insect larvae were also important for Shoshonean diets (Steward 1938:73). Honeybees were spotted in Nelson Wash but no hive was observed. There are few references to aboriginal honey exploitation for the Indians of California, and none could be found for the Mojave Desert.

In sum, Nelson Wash contains a broad range of reptilian, avian, and mammalian fauna. The fauna found here comprise an easily exploitable set of food resources, given dietary preferences such as those known among aboriginal peoples ethnohistorically (e.g. Steward 1938). The presence of a preponderance of relatively small game animals and the current lack of large game accords with the Shoshonean subsistence model and the emphasis on small game predicted for Late Times in the Historic Preservation Plan (Warren et al. 1986).